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BRITISH FOUNDRYMEN'S ASSOCIATION.

The President's Address.

At the recent Convention of the British Foundrymen's Association, at Middlesbrough, Mr. Herbert Pilkington, the new President, delivered the following address:—

Gentlemen,—In addressing you for the first time as President, let me first of all thank you for the honour which you have conferred upon me. It is one which I highly appreciate. I regard Associations and Institutions of this type as powerful factors for educational work; and the British Foundrymen's Association, I think, will inevitably exert great influence on the education of the foundrymen of this country.

The progress of the Association since we first met at Manchester, two years ago, and at Glasgow, last year, has been extremely satisfactory, and has involved much hard work on the part of Mr. Buchanan and Mr. Finch. No Association of this kind can be formed without a good deal of arduous pioneer work, and the overcoming of difficulties incidental to a newly-formed Association; however, "Nothing succeeds like success," and the Association is becoming firmly established as a progressive and substantial Institution. The number of members at the time of the Manchester meeting was 83, and at the time of the Glasgow meeting 121. To-day our members number 180, and I have no doubt that these figures will soon be greatly increased upon.

The objects of our Association have already been amply explained to you, and I think we are fully understood; but I do not think we can too often reiterate the great educational value of our papers and the ensuing discussions, together with the visits to various works.

It is the desire of your Council that, so far as we possibly can, we should induce ironfounders themselves to become members, and take part in our work and discussions. Nothing but good to founders can accrue from an Association formed from such a body of members engaged in all the branches of founding, taking their part in the discussions of scientific and practical founding, and the application of scientific research to every part of it. It is also the desire of the Council that every encouragement should be given to the formation of District Branches of the Association, several of which are now in successful operation. It is manifest that these district Associations could meet more frequently than the parent Institution, and where there are sufficient members for a district Association, if at all possible, it should be formed. This will not only keep the members of the district in touch with each other, but will also materially strengthen the Association in general.

It has often been pointed out that scientific education has not usually formed part of the foundrymen's equipment. I feel convinced that this state of things, however true at one time, is now undergoing a process of considerable

change and improvement; and there is no doubt, that so far as managers and foremen are concerned, they are all of an infinitely superior type to what they were only a short time ago.

It is frequently asserted also that the educational facilities in this country are such that ironfounders and their managers and foremen have not the means of obtaining such scientific, or so-called technical, education, as in some of those countries with which we compete. I am not one of those people who necessarily find fault with our own system, because it happens to be British, any more than I would find fault with the Britisher for the same reason, and I do not think that in these days we suffer much, if any at all, in comparison with other nations, either with regard to *personnel* or education. It appears to me that the higher educational facilities in this country are such as to provide a training as superior as that which can be obtained in any other country. The multiplication of our engineering colleges and universities has been very great, and their equipment has been ample and even lavish; while many, in their departments of metallurgy and engineering have provided themselves with miniature plants for purposes of demonstration and research. So far as these miniature plants at metallurgical and engineering colleges are devoted to such demonstration and research, I do not think they are likely to form the subject of any criticism; but they must naturally be of very little value when it comes to teaching methods of practical work, such as we are accustomed to in the works; indeed, there is a distinct danger, so far as I have observed, that young men coming from these institutions have to spend a considerable time in unlearning a great many things they have acquired, which they had hitherto supposed to be of the nature of practical operations.

I am aware that I am treading on delicate ground, but to me it seems that the alliance between the so-called technical education colleges and those colleges which are devoted to what is, after all, mostly literary education, in the formation of new universities, is one which does not seem to be as yet altogether to the advantage of high-class technical training, and seems rather to turn out men who belong more to the academy than to the workshop. This academical spirit most frequently runs through the whole of the teaching staff, from the professor downwards, and it is this kind of spirit which makes it questionable whether the professor or teacher should be entrusted with the handling of even the toy plants they possess; further, I am inclined to think that no chair of metallurgy or engineering should be occupied by any man who has had only a purely academical training.

Turning to the moulder himself, from what I have seen in several countries, the British moulder, whatever his faults may be, has nothing to fear as a practical man in comparison with those of any nation, and I think we shall have to admit that, as a moulder, technical education has not usually formed part of his equipment.

It is an unfortunate fact in this country, that, as a body, they do not display much eagerness for educational improvement, and apprentices, as a rule, devote themselves very much more to sports than to their own intellectual improvement. This is, no doubt, partly brought about by the character and methods of instruction in the primary schools; and it is a system which will take a considerable time to alter.

This Association does not concern itself with disputes between the employer and the employed, but there is one species of relationship, which I think may be fittingly referred to as an educational matter, which many of us would like to see further developed, and that is, not only should the employers and their managers take the greatest possible interest in the education of those they employ, but they should also take a deep personal interest in their recreations and amusements. Every effort should be made, particularly so at large works, to provide such facilities as gymnasiums, ground for athletics, reading rooms, lecture rooms, libraries, clubs and baths. Every effort of this kind fostered by the proprietors or the management, leading to the improvement of the workman, must, I am convinced, eventually produce a type of men capable of appreciating the advantages of education, and eager to take the opportunities of acquiring it. I would go further, and see that all the apprentices attended certain courses in science classes bearing upon their particular class of work, and, if possible of arrangement, these subjects should be taught by members of the works' staff.

The educational system of this country, both primary and secondary, and that of the Universities, has been undergoing a

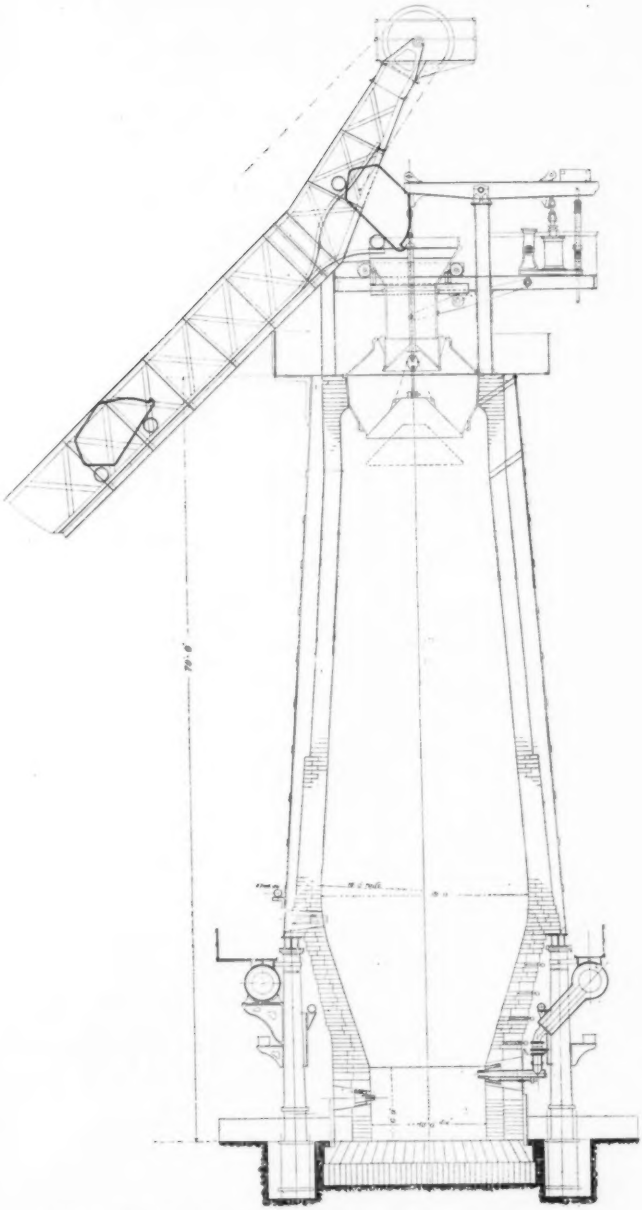

FIG 1.—BLAST FURNACE AT THE SHEEPBRIDGE WORKS, 1900 TO SMELT LOCAL ORES,

period of extensive and far-reaching changes. The primary part of it, in particular, has been slowly changing, but has suffered intensely in its progress, and the elementary education imparted is by no means yet satisfactory; still, as one of those interested in school management and in education generally, I can see

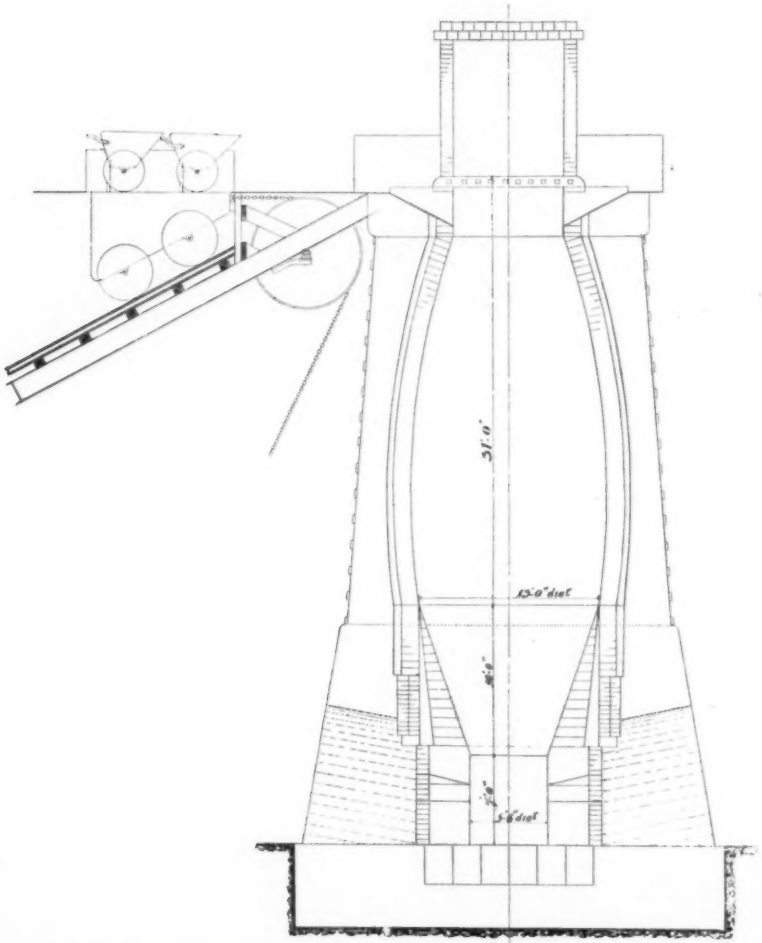

FIG. 2.—STAFFORDSHIRE BLAST FURNACE, 1860. TO SMELT LOCAL ORES.

has been much retarded by the never-ending interference of religious factions, while the cause of education itself has taken a secondary place. There is also no doubt, as was alluded to in a previous Presidential address, that the nature of that considerable improvements have taken place, and, doubtless, will do more rapidly as the practical organisation improves, and the promotion of co-ordination in primary, secondary, and university education progresses. In the

primary schools children should be kept at school until they are older than at present, and the absurd and ridiculous half-time system should be abolished. In the higher standards or higher grade schools, elementary science should be generally taught, and with greater thoroughness than the Education Department have hitherto taught it.

While the science and art section of the Educational Department has been of great use to many of our workmen, and has enabled numbers of them to become foremen and managers, its methods of teaching cannot, up to the present, be regarded as satisfactory, or at all thorough, and it appears that the hope in the future lies with the fusion of this department with evening continuation schools, and the higher grade and secondary schools staffed with a superior class of teachers.

At a meeting in such a place as Middlesbrough, with its historical name in all that concerns iron or engineering, it cannot be but a subject of interest to refer, in some measure in this address, to the manufacture of pig-iron and the blast furnaces in which it is made. The whole basis of the beginning of the iron trade at Middlesbrough and the very great increase in the production of pig-iron subsequently, was the discovery of ironstone in the Cleveland hills, and although Middlesbrough now imports very large quantities of foreign ores, its own ore was really the basis, and is still, of the iron and engineering trade it possesses. There have been many authorities who have expressed alarm at the impending scarcity of iron ore in the future, and who have pointed to the fact that we import some eight million tons of ore per year, while we only raise about fourteen million tons. It may be pointed out, however, that almost the whole of the imported ores are used for the purposes of acid steel-making, so that practically all the iron which is used in foundries is made from British ores, and the ironfounder, whatever happens to the steel-maker, need have no fear with regard to the future of this class of material for a long time to come.

The lias and oolitic ore deposits of this country begin in the Cleveland hills, and stretch all the way, more or less regularly, through Lincolnshire, Rutlandshire, Leicester, Northamptonshire, and Oxfordshire, to Kent and Sussex, and this latter county was doubtless the earliest home of iron production. Many of the authorities appear to have held the extent of these ores to be of little account, which, in my opinion, from long experience in working them, is an entirely mistaken view to take. In the Midland districts, in many instances, the surface outcrops only have been worked, and then only the richest taken, while in the deep, vast quantities of ores remain untouched, more or less similar in origin to those in Middlesbrough, but much richer. There are also large quantities of ores which apparently are not seriously regarded at present in the oolitic districts, and these are surface ores with an iron content varying from 18 per cent. to 23 per cent. of iron. If these ores could be cheaply concentrated, as they undoubtedly will be, then, indeed, the supply of foundry pig-iron is most amply guaranteed for long periods to come. These ores have always been, since they were worked, chiefly used for making foundry pig-iron, for which purposes they are eminently suitable, and they form absolutely the cheapest and most plentiful sources of supply in this country. The Cleveland district alone raises nearly six million tons of these lias ores per annum.

Nothing is more striking to contemplate than the remarkable increase in the world's production of pig-iron. This production in 1905 was 54 million tons, it having exactly doubled itself in 15 years. Of this, the United States of America made 22,992,380 tons, Germany 10,987,623 tons, Great Britain 9,592,737 tons.

Great Britain has taken practically no part in this huge increase of production, which has been mainly confined to America, Germany, France, and Belgium.

In 1867 the world consumed approximately 20 lbs. of iron per head of population. In 1905, this amounted approximately to 85 lbs. per head of population. The United States of America now consumes about 600 lbs. per head of population per annum, while the United Kingdom consumes about 500 lbs. per head. If we consider 85 lbs. as the world's average consumption, and remember that there are vast populations with a consumption of under 1 lb. per head, it will be seen that there is every prospect of still more startling increases of production of pig-iron before the degree of average civilisation reaches that of the enormous consumption of 600 lbs. per head.

Cleveland ore appears to have been brought into use in a practical way in 1850, and the furnaces of that time did not exceed from 45 to 50 ft. in height, and did not greatly exceed a make of 100 tons of pig-iron per week. We shall have the opportunity during this visit of seeing furnaces on Cleveland ore making 1,400 to 1,500 tons per week of iron, in furnaces 90 to 100 ft. high. These figures, of course, pale to insignificance when contrasted with the huge makes of hematite at Pittsburg, where over 600 tons per day is an ordinary output, but they sufficiently indicate the great progress made in blast furnace practice in Cleveland.

Previous to 1850 it would require four to five tons of coal, used as coke, to make a ton of pig-iron. Neilson's hot-blast was introduced about 1835 in Scotland, and the Cowper stove about 1862 in Cleveland, and by means of these and other improvements, amongst which should be mentioned the by-product coke-ovens now so general, the consumption of coal per ton of pig-iron is as low, or lower, than 30 cwts. when using Cleveland ore. This 30 cwts. of coal used in the form of coke, is the only fuel used for the production of pig-iron, as the hot-blast is produced, and the steam for all power operations is raised, by means of the so-called waste gases, which, prior to 1860, had mostly escaped to waste at the tunnel head, although closed tops were introduced at Ebbw Vale in 1848.

A further development in furnace practice has taken place recently, and that is, the generation of power by means of the blast-furnace gas engine. By this means very large quantities of power can be produced for use in operations quite external to the blast-furnace itself. With the assistance of Mr. Thwaite I put down gas engines at Sheepbridge Works so far back as 1899, by means of which power was generated from blast-furnace gas to operate a large new pipe foundry, and to-day the power required for the production of some 600 tons of pipes and castings per week, and the machine shops connected with them, is wholly produced by means of blast-furnace gas; the furnaces furnishing not only the power, but the iron as well. This was probably the first successful installation for power production from blast-furnace gas in this country. The small engines installed by Mr. Riley at Glasgow were, indeed, previous to this, but were used for electric lighting. There were also at least two other engines which, however, did not continue their operations. There is an enormous field for development in this direction, and the Association will see a very notable installation at one of the works they will visit during their stay at Middlesbrough.

By the use of blast-furnace gas in internal combustion engines, there is a very great economy of gas used, the consumption being only about 110 cubic feet per i.h.p. developed, as compared with four to five times that quantity when used by means of steam boilers and steam engines.

As the average blast furnace produces about 170,000 cubic feet of gas per ton of pig-iron produced, it will readily be seen what enormous sources of power are available. If the power required for the blast furnace operations were produced by means of internal combustion engines, probably half the gas produced could then be utilised for the production of power for other purposes. This suggests that in the future blast furnaces will become, as it were, gas producers to plants required for turning pig-iron into finished products, and that all finishing plants, of whatever character, in future, will be incomplete without blast furnaces to supply the requisite power to drive them.

This evolution would appear to be quite a natural one when applied to the large iron and steel works of this country, some of which it will be our privilege to visit in Middlesbrough, but to those who are also connected with foundry work in its largest developments, it appears that the application of this source of power will be by no means confined to steel works, but will also be applied generally, as it has been, to foundry operations.

An ideal plant for large or heavy foundry operations might be described as having blast furnaces as its essential central factor making pig-iron, and producing gas in sufficient quantities to supply all the power required, the power being generated by means of gas engines working on the blast furnace gases, and either driving the machines direct, or generating electrical power and transmitting it to the various shops. All the foundry stoves could be heated with blast furnace gas. The pig-iron could be run into ladles, passed through a mixer, kept hot by blast furnace gas, and the metal for the castings taken from the mixer direct, without the intervention of a cupola in any shape or form; thus, no fuel would be used about the plant

except that put into the blast furnaces themselves for producing the pig-iron. No electrical smelting plant of any kind could ever possibly compete with a plant of this nature. Pig-iron used direct in this manner for making castings is an infinitely superior metal in every way to that melted in the cupolas; it is much softer and has a lower content of sulphur and manganese than the re-melted iron from the same stock.

The heavy increase in the production of iron at blast furnaces in recent years has naturally reduced the cost of labour required to produce it, and this has been still further reduced by the almost enforced necessity for the mechanical handling of such large quantities of materials in a given time. In the case of the pig-iron, this has led to its being handled molten by means of ladles, either in connection with a mixer or a casting machine, or by handling it cold by means of electric cranes and breaking machines.

The most striking mechanical development, however, has been in the handling of the materials charged into the furnace top. The ores and fuel are dropped from hopper-bottomed wagons by gravity into bunkers; from these they are also drawn by gravity into electrically-propelled trollies, upon which they are weighed; they are then delivered by these trollies to the furnace skips, into which they are dropped again by gravity. These skips are on an incline, and are drawn electrically to the top of the furnace, where the materials are automatically dumped into the hopper placed over the top of the bells. There are no men on the top of the furnace, all the operations of hoisting and bell-lowering being governed by means of levers operated by the trolleyman at the foot of the incline. Such a furnace I have illustrated on the diagram, which is before you; it is one which I erected at Sheepbridge Works in 1900. I believe it was the first furnace of this type in this country, and, at any rate, it is the only one which has been so long in operation, having blown continuously and successfully on the same lining ever since. I have placed beside it, for the purpose of contrast, a diagram of a Staffordshire furnace of 1860, of which I possess the original drawings. The two diagrams are drawn to the same scale, so that an idea may be formed of their respective sizes, as well as of the contrast in their designs. It will be noticed that the Staffordshire furnace has an incline, also, certainly, of a much more primitive design, but yet suggestive of the transition to the modern system. The members will have an opportunity of seeing some of these modern plants during their visit.

With regard to the pig-iron itself, perhaps the most notable development of recent years has been the application of the new science of metallography to the examination of the internal structure of the iron, and the revelations it has made with regard to its different crystallisations, according to the way it has been cooled down from the molten to the cooler state. May I point out, with regard to this development, that the examination of pig-iron, by means of the microscope, in order that we may examine its crystallisation, is only a development of the judging and grading of it by fracture, the one is done by means of the microscope and the other by means of the naked eye. As there is a paper on the grading of foundry iron I will make no further comment, except to say that it still appears that not only must the analysis be taken into account, but also the crystallisation.

Turning briefly for a moment to the foundry itself, I should like to see some papers given before the Association upon the subject of "Cupola Practice," particularly with regard to the economy of coke in melting. This subject is one with which I have often had to deal, and in a lesser way is almost as interesting as that of the blast furnace. As a matter of experience, I may relate that certain cupolas in Staffordshire, which were blown by the blowing engines attached to the blast furnaces—that is to say, the blast pressure was about 3½ lbs. at the engines—in the course of time were blown by a Roots blower at about 1½ lbs. pressure. The result was an immediate large reduction in the consumption of fuel; the only other alteration was that the tuyere area had to be increased to get in the requisite volume of blast at the lower pressure. Again, in applying electricity to blowers in recent years, it has been found more convenient to use electrically - propelled fans, directly coupled, instead of Roots blowers; the blast pressure from these fans is less than that of the Roots blowers, and tuyere area has had to be somewhat increased to compensate for this. The result has again been a saving in coke. All this experience goes to show that the quantity of blast blown into the cupola should be regulated by the tuyere area and revolutions of the blower, and the

pressure of the blast should be kept low. Every increase of working height in a cupola, so far as my experience has gone, has resulted in an economy of coke, and it is an interesting point as to how high the charging level may be raised relative to the capacity of the cupola and the question of blast pressure. The ordinary foundry cupola suffers a serious disability, inasmuch as its operations are intermittent, and the coke for the bed is a necessary loss which has to be faced daily. In steel works, where cupolas are in continuous operation, the coke consumption is astonishingly low, and steel works practice in cupola work has many interesting features which founders might with great profit study.

There are many other subjects of interest to foundrymen which might well have been touched upon in this address, but there are limits within which it is well to confine it, having regard to the place of meeting and my own especial interests in its iron developments.

I sincerely hope that in all matters of practical interest in the foundry the members of the Association will not hesitate to make them the subjects of papers and discussions, as well as those more scientific subjects which we have had so generously placed before us. There is plenty of room for investigation, as the most casual study of the scrap or waste heap will any day show at the smartest foundry.

The object which this Association has most particularly in view is to throw plenty of light about all the practical operations of foundry practice. Our duty is to sweep away all the supposed mysteries of the foundry, and effectually to remove the empirical from all foundry operations.

I entertain no doubt whatever that the Association will most worthily fulfil its destiny.

Mr. Mather (Ashford, Kent): I think we should pass a very hearty vote of thanks to our President for his able paper. We, in Kent, see very little of the iron district. In the early seventies I was working in Sheffield. Since I left Yorkshire I have seen very little, about London and the South of England, of the iron industry. As regards the Kent industry and the Sussex industry, it may be interesting to some to know that as far back as 1500, cannons were made for the French Government. I have in my possession some old firelocks which the Americans in particular are anxious to get hold of. They are dated 1600. I have one dated 1649, which was made in Kent. I beg to move that we pass a very hearty vote of thanks to our President for his able address.

Professor Turner (Birmingham): I should like to second. We do not propose to discuss it, nor do we say that we agree with everything you have said. You have given us matter for consideration, and we are much indebted to you.

The President, in responding, said if they were pleased he was amply repaid. He had a suspicion at the breakfast table at the hotel that morning that Professor Turner thought something would be said which he would like to criticise very much. But he believed it was a rule in most societies that the President's address was not discussed, though he would, no doubt, get plenty of personal criticism from Professor Turner himself.

GRADING PIG-IRON FOR THE FOUNDRY.

By P. Munnoch.

Mr. P. Munnoch (Middlesbrough) then read his paper as follows:—

Although several schemes for grading pig-iron by analysis have been proposed, the practice of buying to analysis for foundry purposes has made little headway in this country.

This is due to some extent to the fact that no system yet proposed has been wide enough in its scope to suit the requirements of all branches of the foundry industry. Most of these systems have been based either on a fixed ratio of silicon to sulphur, or on a maximum sulphur, the grade being determined by the amount of silicon.

Owing to the extreme variations of the ratio of silicon to sulphur occurring in all grades of every brand of pig-iron made, none of the methods proposed could include more than a small proportion of the irons now used in the foundries. The inevitable result of the adoption of such schemes would be the immediate increase in price of the iron sold to these specifications, as the majority of furnaces would be unable under present conditions to turn

out half their make to suit these specifications. If they were able to do so and all iron made came within these specifications, it would be the greatest misfortune that could possibly befall the foundry industry.

Different classes of castings require vastly different composition, and no scheme for grading by analysis hitherto put forward is sufficiently elastic to suit all requirements. Founders making one class of work may require No. 3 iron with 3 per cent. of silicon, but others making a different class of work may require No. 3 iron with 1 per cent. of silicon, whilst generally silicon between these limits is required. Those buying No. 1 iron require a soft iron with low sulphur and high total carbon, and may prefer 4 per cent. or only 2 per cent. of silicon. Similarly in the case of the lower qualities, say No. 4 forge, some prefer above 2 per cent. silicon whilst others require below 1 per cent.

As both high and low silicon irons of similar grade are a necessity in the foundry, it would be detrimental to the interests of the industry if all iron was made either high or low silicon to suit the requirements of one branch only.

Considering the matter from another point of view, some furnaces are so situated that they are best able to turn out iron high in silicon, that is comparatively high throughout all grades, whereas others are so situated that they can, with more advantage, turn out low silicon irons. What is required is that those who use either one or both of these extremes, or iron of intermediate silicon contents, shall be able to obtain them with more certainty and regularity than is the case at the present time.

From the point of view of those making large castings, the curse of most foundry irons is high silicon. It is a very difficult matter, in some districts, at the present time to procure iron, especially the lower grades, with a sufficiently low silicon. The tendency of most irons is towards high silicon, this is due to some extent to the leaner and more silicious ores now used, to the rapid driving and modern methods of working, and possibly to a small extent to the persistency with which the virtues of silicon, as the universal remedy for all the troubles to which the foundry is heir, are extolled in foundry literature.

There is no doubt that high silicon iron is of very great advantage, especially where sulphur is usually high or where very thin castings have to be made, especially so if these require much machining. Generally speaking, however, a high silicon is only a poor substitute for low sulphur.

"Grading by Fracture."

The question as to what the grade of pig-iron depends on is rather difficult to answer, as it does not depend entirely upon the amount of any one element, but on a combination of several. Taking a broad view of the matter from No. 1, through the several grades down to white iron, it will be seen that sulphur is practically the controlling element. This controlling power is modified to a more or less extent by the relative amounts of the other constituents, but chiefly by the amount of total carbon present. The total carbon must, however, be considered in relation to the phosphorus present, and also to some extent to silicon when much above or below the normal is present.

Practically silicon varies more than any other element in the composition of foundry pig-irons. Although silicon has great influence on the properties of castings, it has very little influence on the grade of pig-iron as determined by fracture. Therefore we are able to obtain pig-irons almost identical in fracture, and therefore similar in grade which may contain from 1 per cent. to 4 per cent. of silicon, and even greater variation than this is possible.

The character of the irons produced in different districts depends chiefly upon the amount of manganese and phosphorus present, but the varying amounts of these elements have practically no effect on the grade of ordinary foundry irons; those high in phosphorus have a lighter coloured fracture than low phosphorus irons.

In addition to chemical composition the grade of pig-iron depends upon, and is modified by, the varied conditions of casting and cooling.

As the grade is determined by the size of the grains or crystals, it varies to some considerable extent with the judgment of the sampler. In mottled iron, white iron, and glazed iron there is a distinct characteristic appearance, apart from size of grain.

The following tables show the extreme variations in composition of irons I have met with. I give the irons classified according to the grade for which they were bought, and also those I considered properly graded. Others may have met variations outside these extremes:—

TABLE No. 1.

Silicon.	Silicon in irons bought.	Silicon in irons properly graded.
No. 1 iron ...	1.05 to 5.25	1.05 to 5.25
No. 2 iron ...	1.20 ,, 4.82	1.20 ,, 4.85
No. 3 iron ...	.72 ,, 5.90	.80 ,, 4.40
*No. 4 (foundry)	1.20 ,, 4.00	1.20 ,, 3.50
No. 4 (forge) ..	.50 ,, 3.80	.50 ,, 2.90
Mottled ...	.50 ,, 2.15	.50 ,, 2.15
White... ...	.45 ,, .80	.45 ,, .80

* Close No. 3 included as equivalent to Cleveland No. 4 Foundry.

TABLE No. 2.

Sulphur.	Sulphur in irons bought.	Sulphur in irons properly graded.
No. 1 iron ...	.005 to .05	.005 to .05
No. 2 iron ...	.005 ,, .05	.005 ,, .05
No. 3 iron ...	.010 ,, .15	.010 ,, .07
No. 4 (foundry)	.025 ,, .15	.030 ,, .10
No. 4 (forge) ...	.050 ,, .220	.060 ,, .195
Mottled ...	.150 ,, .295	.170 ,, .280
White ...	.200 ,, .500	.200 ,, .500

TABLE No. 3.

Carbon.	Total carbon in irons bought.	Combined carbon in irons bought.
No. 1	3.15 to 4.85	Nil to .96
No. 2	3.15 ,, 4.06	,, ,, .92
No. 3	2.45 ,, 4.20	,, ,, 1.23
No. 3 close ...	2.80 ,, 3.95	,, ,, 1.50
No. 4 foundry ...	2.60 ,, 3.45	,, ,, .62*
No. 4 forge ...	2.98 ,, 3.95	,, ,, 1.60
Mottled	2.85 ,, 3.70	1.0 ,, 2.5
White	2.83 ,, 3.60	2.83 ,, 3.60

* No. 4 Foundry Cleveland iron only.

The following table is taken from an article by O. Zeyde, in "Stahl und Eisen," mentioned in the "Journal of the Iron and Steel Institute," Vol. 2, 1904, page 624 :—

Silicon average of 90 works in the United States.

Compiled from analyses of pig-iron by Seymour R. Church, U.S.A.

TABLE No. 4.

—	Silicon.
	Per cent.
No. 1	From .90 to 4.0
No. 2	,, .35 ,, 3.8
No. 3	,, .4 ,, 3.1
No. 4	,, .20 ,, 2.4
No. 5	,, .10 ,, 1.75
No. 1 soft	,, 2.10 ,, 5.50
No. 2 soft	,, 2.30 ,, 4.50

Most of the above are from makers' own figures, and show that irons of similar grade, with high and low silicon contents, are made and used in other countries besides our own.

From the foregoing examples it will be seen that silicon varies to a very great extent in each grade.

Sulphur also varies, but the limits are more readily defined, and there is a regular increase. In actual practice we find that the sulphur is generally within certain limits, and the fracture to a great extent indicates the sulphur.

Total carbon also varies to a great extent, and in conjunction with sulphur practically governs the grain. Where total carbon is low the grain is smaller than indicated by sulphur present.

An iron with a high content of total carbon will carry more sulphur without affecting appearance of fracture than one with normal carbon. Conversely an iron with a total carbon below the normal will have a smaller grain and will therefore appear lower in grade.

Total carbon must always be considered in conjunction with phosphorus, as an iron low in phosphorus can carry more carbon than a high phosphorus iron. Usually 1.5 per cent. of phosphorus displaces about 0.5 per cent. carbon.

Comparing the results tabulated, it will be seen that no table, however drawn up, could possibly include all these variations.

These results are extremes met with in practical experience with over 40 brands of iron, and are much greater than can possibly occur in any one brand. However, taking any one brand, considerable variations occur from time to time, though some vary to a much greater extent than others.

"Systems for Grading by Analysis."

Iron for the foundry, except in very few cases, is graded and sold by fracture alone. Where hematite iron is made it is often sold to analysis, and the iron is graded by fracture or analysis, as is convenient, but unless specified, the iron is not sold by analysis.

Practically the grade is determined by the amount of sulphur present, the following being the usual limits:—

TABLE No. 5.

No. 1 sulphur not over	.035
No. 2 ,, ,, ...	.045
No. 3 ,, ,, ...	.060

No. 4 All above .06 sulphur which is not mottled or white.

The following table is that adopted by the London Metal Exchange for British foundry irons:—

TABLE No. 6.

—	Silicon.	Sulphur.	Phosphorus.
No. 1 ...	2.3 to 3.5	Not over .035	Not over 1.65
No. 2 ...	2.5 to 3.5	,, .045	,, ,,
No. 3 ...	1.75 to 3.0	,, .060	,, ,,
No. 4 ...	1.50 to 2.5	,, .080	,, ,,

This table is based on sulphur contents, the limits of silicon given are those within which the bulk of "Cleveland iron" of these grades, would be expected to fall, if made under average conditions.

Below is given a table for British foundry iron from a paper read before this Association by W. B. Parker, who, it will be seen, bases the grading principally on the silicon and combined carbon:—

TABLE No. 7.

Grade.	Silicon.		Combined carbon.	Sulphur.
	Required.	Limits allowed.	Maximum.	Maximum.
No. 1...	3.5	4.0—3.25	.10	.05
No. 2 ..	3.25	3.5—3.00	.20	.05
No. 3...	3.00	3.25—2.75	.30	.05
No. 4...	2.75	3.00—2.50	.40	.06

The following table is that adopted by the American Foundrymen's Association:—

TABLE No. 8.

Grade.	Silicon.	Sulphur.
No. 1	2.75	.035
No. 2	2.25	.045
No. 3	1.75	.055
No. 4	1.25	.065

The foregoing tables may be convenient for defining standard qualities, but a great quantity of iron now used in the foundry is outside the limits given.

"Grading by Analysis."

The system of grading by analysis most suited to both the foundry and the blast furnace is one in which the grade is based upon a fixed scale of sulphur contents.

No. 1 iron, in addition to sulphur, requires specification of total carbon or fracture.

The following table shows proposed sulphur limits, the grade numbers being those in general use in this district.

The sulphur limits given would include the bulk of the iron graded to these numbers by fracture:—

TABLE No. 9.

Grade.	Sulphur.	Silicon.	Total carbon.
No. 1 ...	Not over .01	To Specification, with .25 per cent. allowance above or below amount specified	*
No. 2 ...	,, .01		Not specified
No. 3 ...	,, .06		,,
No. 4 (foundry) ...	,, .08		,,
No. 4 (grey forge) ...	,, .12		,,
No. 4 (hard forge) ...	,, .18		,,
Mottled ...	,, .28		,,
White ...	All over .28		,,

* No. 1, iron not under 3.3 per cent. total carbon, Cleveland irons ... } Medium silicon;
No. 1, iron not under 3.8 per cent. total carbon, hematite irons ... }
or No. 1, fracture accepted as equivalent to above carbon contents. Variation of sulphur allowed, .005 per cent. above standard for Nos. 1, 2, and 3, .01 per cent. above for No. 4 and lower qualities.

Using this system of grading, founders would order iron of any definite grade (or equivalent sulphur) with 1 per cent. or 3 per cent. silicon, or any other percentage of silicon required.

When iron of definite silicon contents is ordered, should iron of that particular percentage not be available, the equivalent amount of same grade irons which would give the required percentage when mixed, would be taken if advised and shipped separately, but in no case would iron of above 0.50 per cent. variation either way be taken except by special arrangement.

In addition to grade (*i.e.*, sulphur) in place of ordering iron to any definite percentage of silicon, the following, or some similar, classification can be used.

For the purpose of defining standard qualities, and for convenience of stocking, this system (Table No. 10) will probably be more acceptable to the blast furnace people.

Glazed iron (silicious iron) would be classified as special high silicon iron, and would usually fall within sulphur limits of No. 2 and No. 3 qualities.

Using this classification founders would order iron of any grade (or sulphur) of high, medium or low silicon or special high or special low silicon when these extremes are required.

There are furnaces the bulk of whose make of pig-iron would be medium silicon if classified according to Table 10. There are others making iron almost en-

tirely below the medium in silicon contents, whilst other furnaces turn out iron which seldom falls below the high silicon classification.

In all cases where iron is sold to analysis, or grade and silicon classification, as outlined above, the actual analysis of sulphur and silicon in the iron sent must be given to the buyer.

Considering the requirements of analysing, selecting, and stocking to analysis, it is questionable whether the bulk of pig-iron makers are in a position to sell to analysis.

There are furnaces, even in these days, who do not keep a chemist, and there are many who do so who confine their attention almost entirely to the materials they buy, and pay very little to the iron they produce.

There are also some who do partial analysis as a daily routine, but who if asked for a complete analysis would have difficulty in finding one of recent date in their books. There is no doubt a small minority who could, without much additional expense, sell the bulk of their iron to analysis.

However, even if the pig-iron producers were able to sell to analysis, very few founders have sufficient knowledge of their requirements, as regards analysis, to be able to take advantage of that system.

"Selling by Grade and Silicon."

As an alternative to selling entirely to analysis, I propose a system intermediate between that at present in use and that just outlined, namely, buying by grade and silicon. This is an advance on the present system, and is practically the first step towards buying by analysis.

This method incurs very little expense for analysis at the furnace, and can be worked in conjunction with selling by fracture or selling by analysis.

Providing the silicon is known, the fracture of pig-iron is generally a satisfactory guide to its behaviour in the foundry. That is to say, the fracture usually indicates the amount of sulphur or the ratio of sulphur to total carbon.

With this system the grade and silicon classification according to Table 10 would be used. As the grade would be determined by fracture, sulphur would not be guaranteed, but would usually be found within the limits given.

Founders using this method of buying would order any definite grade with medium, high, or low silicon or special high or low silicon as required.

With hematite irons, No. 4 grade includes the three No. 4 grades given in Table 10, it would be more convenient for founders using these irons if the grading of this table was adopted, and possibly more profitable to the makers, as a graduated decrease in prices could be substituted in place of the present differences in price between No. 3 and No. 4 qualities.

Under the present system of grading by fracture, a founder ordering No. 3 iron may require 3 per cent. of silicon; should the iron on the pig beds contain 1 per cent. or any other amount, if the fracture is No. 3, it is shipped independent altogether of what his requirements are, and in all probability the founder who requires No. 3 iron of 1 per cent. silicon will get No. 3 iron with 3 per cent. when it is made. Buying to foregoing classification of silicon would enable the founder to buy iron of more uniform silicon contents.

Actual analysis of silicon contents, must be given by the pig-iron makers of all iron sent out. Where possible, sulphur contents might also be given, but

TABLE No. 10.

Grade.	Sulphur.	Silicon.				
		Special low.	Low.	Medium or standard quality.	High.	Special high.
No. 1	Not over .04	Below 1.8	1.8 to 2.5	2.5 to 3.3	3.3 to 4.0	Above 4.0
No. 2	,, .04	,, 1.8	1.8 to 2.5	2.5 to 3.3	3.3 to 4.0	,, 4.0
No. 3	,, .06	,, 1.5	1.5 to 2.2	2.2 to 3.0	3.0 to 3.8	,, 3.8
No. 4 (foundry)	,, .08	,, 1.3	1.3 to 1.8	1.8 to 2.6	2.6 to 3.3	,, 3.3
No. 4 (grey forge) ...	,, .12	,, 1.0	1.0 to 1.5	1.5 to 2.0	2.0 to 2.8	,, 2.8
No. 4 (hard forge) ...	,, .18	,, .8	.80 to 1.3	1.3 to 1.8	1.8 to 2.5	,, 2.5
Mottled ...	,, .28	—	Below 1.0	1.0 to 1.5	Above 1.5	—
White... ...	All over .28	—	,, .5	.5 to 1.0	,, 1.0	—

no guarantee of sulphur limits would be given, fracture and silicon limits only being guaranteed.

As either of the foregoing systems would only come gradually into general use, the iron producer would be able to select iron of definite analysis for those requiring it, and sell the remainder as at present to those requiring fracture only.

The proposed silicon classification would not be entirely suitable to those making only low silicon irons, such as cold blast irons. In this case makers themselves could draw up a table of classification based on a lower silicon content.

Before selling by analysis can make any progress, the makers of pig-iron will have to give more information regarding the general composition of the irons they make, and the usual limits of silicon in the different grades. They will also have to state the limits of variation they are willing to guarantee, and whether they are willing to adopt or sell by any of the various schemes put forward for grading or selling by analysis.

PIPE FOUNDING—IV.

By W. E. Cowens.

Having dealt with the requisite plant, we may now proceed to consider the general arrangement of the pits. Fig. 23 shows an arrangement for pipe boxes to be all on bogies, as already described in detail. A B C D is the pit, it is oblong in shape, and about 12 ft. deep from the rail to the coping level, and has three sunk ways for traverse bogies. Three

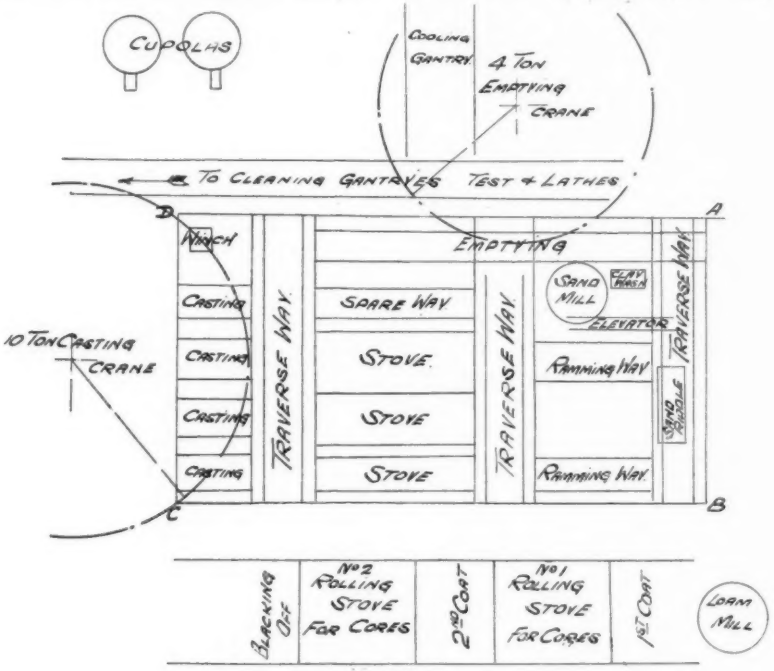

Fig. 23.

stoves for the moulds are provided in the centre of the pit, having rails running through them, and folding doors at each end, to allow the boxes to be pushed straight through. Two ramming ways are provided, so that two sizes of pipes may be worked together if required. Between these ramming ways and also over the sand mill, platforms are provided for ramming, planks being placed across the ramming ways to allow the rammers to work round the box. An elevator of the ordinary bucket type lifts

the sand from the mill, and discharges it into a revolving riddle, and it is delivered from this riddle on to the platform ready to shovel into the mould. One 10-ton crane is provided for casting, and a 4-ton crane for emptying. The casting crane is made strong enough to lift out box, bogie, spindle, and pipe, so that if an accident occurs, such as a spindle getting fast, the whole may be lifted out of the way, and no stoppage occur to the pit. A smaller crane, not shown on the plan, is provided to lift

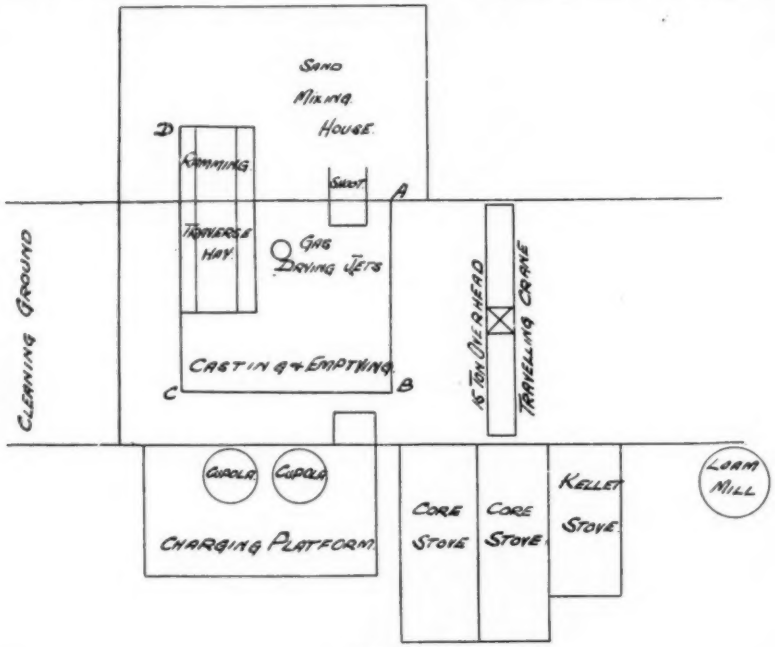

FIG. 24.

before being sent out on the bogie to the cleaning gantries.

The cleaning gantries are arranged at right angles to the tramways, and of such a height that the pipes can be rolled off the bogie on to them. The gantries are so arranged that the pipes after being cleaned roll forward to the lathes, and from thence to the pipe test and blacking pot.

Before blacking, the pipes must be uniformly heated, and for this purpose a stove is provided so that the pipes may

off the half-box and hold it whilst emptying. For dealing with the patterns two winches are fixed in the roof, so that the pattern may be lifted clear of the box as soon as it is rammed. The clay wash tank is on the platform above the sand mill, and has suitable pipes and cocks, so that the wash can be sprayed on to the sand as required. A small hand-winch is provided in the corner of the pit for pushing the boxes out of the stoves on to the traverse bogie. A cooling gantry is provided near the emptying crane so as to allow the pipes to cool

be rolled into it, and also rolled out when heated to the blacking pot. The blacking pot is provided with a fire underneath to keep it at a temperature of about boiling point.

The cores are dealt with by the rolling stoves placed at the side of the pit; the first coat being put on at one end, dried in No. 1 stove; second coat is put on between the stoves, and then rolled in to No. 2 stove, being blacked off at the end ready for the mould. A suitable bogie is provided to convey the core to the pit, and it is also used to take the

bar from the pit to the end of stove No. 1 for first coat. A loam mill is provided adjacent to the core stoves, and suitable gear for turning the core bars whilst being coated.

The cupolas for melting the metal are also closely adjacent to the pit.

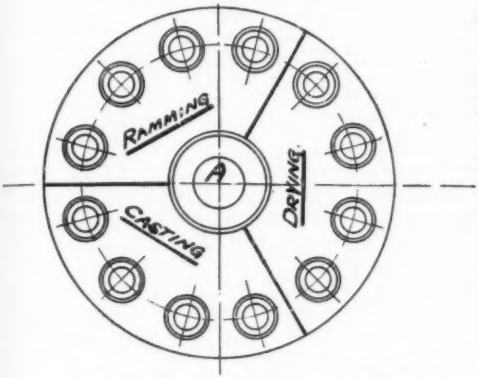

FIG. 25.—PIT. (WITH CENTRE CRANE.)

This arrangement is very complete, but a large amount of labour is entailed in moving the boxes. In the rolling stoves there is also a tendency for the loam to be shaken loose with the rolling.

Fig. 24 shows an arrangement of pit in which the bogies on the boxes are altogether dispensed with. A B C D is the pit, which is provided with a traverse way and bogie for taking the box into the sand-mixing house to be rammed. The bogie has fitted upon it a suitable winch for lifting up the socket patterns. In other respects the box is dealt with in the same manner as already described. When rammed it is pushed back into the pit, and lifted by means of an overhead crane over one of the gas-drying jets in the pit—about six of these are in use—a 42 in. box being dried in a little over two hours. The kellets are made in a separate stove shown at the side of the shop, one of these after being prepared is placed on the casting way and the box is lifted on to it and cottered up. The cores are prepared in the body of the shop and dried in stoves alongside the kellet stove, all being gas fired. The core is put in and out of the stove on a bogie, and lifted by means of the overhead crane into the mould. The same crane lifts the metal for casting, draws the spindle and then lifts the box out and conveys it to the cleaning ground for emptying. Suitable lifting apparatus is provided for dealing with the ramming pattern, and a loam mill is placed in a convenient position near the core and kellet stoves. The cupolas for melting the metal are immediately in front of the casting end of the pit, and the charging platform has a small projection into the shop, to allow the gits, head and runner, together with any left metal, to be put into a small wagon and lifted by the overhead crane on to it and put direct back into the cupola.

The sand is prepared by hand in a separate mixing house adjoining the ramming; a shoot is provided so that the sand, after a box has been emptied, can be shovelled into a skip, and tipped by means of the overhead crane to the mixing house.

Outside the gantries for cleaning and dressing are arranged, as already described, the pipes rolling forward to the lathes, test, and blacking pot, etc.

This arrangement with the overhead crane does away with a large amount of labour, and is very convenient in the event of a spindle getting fast, or a box running out, as no stoppage need occur, it can be lifted away by the crane, and special men told off to deal with it,

FIG. 26.—TURNTABLE TYPE.

without interfering with the work of the pit.

Fig. 25 shows the circular pit largely in use in the Midlands. It has a central crane at A, and is divided into sections for ramming, drying and casting, the crane performing all the operations necessary, including lifting the box out of the pit for emptying. The drying is

done by means of gas jets. The box is first rammed, then lifted on to one of the jets to dry; it is then lifted on to the kellet, which has been separately prepared, and placed ready in the casting way to receive it. The core is now lifted in and set, and the pipe is ready for casting. The cores and kellets are prepared in a similar way to that described for Fig. 24.

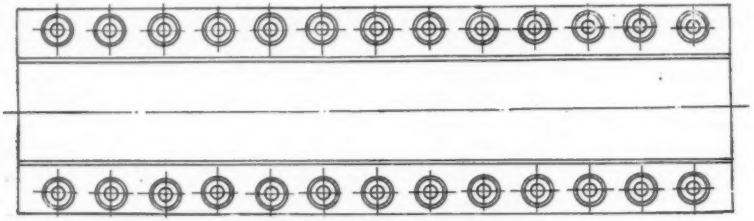

FIG. 27.—PIT (FIXED BOX TYPE).

Fig. 26 shows a circular pit with a centre crane, but has a turntable revolving round the centre pin, one-half being used for ramming and casting, and the other passes into an enclosed portion forming a stove for drying the moulds.

Fig. 27 shows an oblong type of pit with fixed boxes. In this case the box is attached to the side wall and each

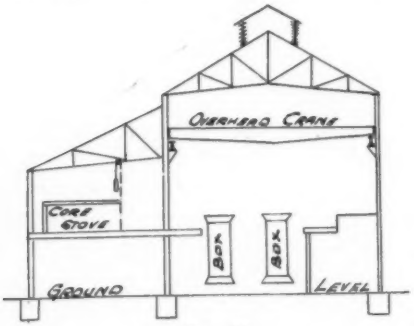

FIG. 28.

one has a gas jet under it for drying it after being rammed. It is served by an overhead traveller, which empties the boxes, puts in the cores, and brings up the metal for casting. The boxes are hinged and open out to allow the pipe to be withdrawn. The centre portion of the pit between the boxes is covered with cast iron grating, and there is an opening at the end to allow the workman to go down and fix up the kellets, and do the other necessary work. This type of pit is only suitable for a continuous run of the same size of pipe, as the boxes when once fixed cannot be readily altered.

In all the arrangements described, pits have been used—these are objectionable in many ways—chiefly. The space for men to work in is naturally confined—should any accident occur the man cannot get readily out of danger—and the air in them becomes hot and vitiated, and the maximum amount of work cannot be obtained from them, especially in summer. German founders have appreciated this, and Fig. 28 shows a section through a foundry where they are entirely dispensed with. The boxes are served by an overhead crane, and stand on the ground level; a strong fire-proof flow is provided at the ramming and casting level, and on this floor under a lean-to are placed the core and kellet stoves; underneath are the lathes, pipe tests and cleaning gantries. The cupolas are on the right-hand side, and deliver the metal at the ground level, suitable wells being provided for lifting the metal up to the higher casting level as required. In this arrangement I understand larger outputs are obtained than from the pits, and if this is so it must be entirely due to the better conditions under which the men work, and to the free access of air about them, and is therefore worth the attention of pipe founders in general in this country, where pits seem to be the rule.

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W. T. GLOVER & COMPANY, LIMITED, Trafford Park, Manchester, have appointed Mr. J. H. C. Brooking, as their sole representative for the North-Eastern district of England, and South-Western district of Scotland.

CLEANING CASTINGS WITH THE SANDBLAST.—III.

An improved machine, introduced by Vogel & Schemmann, is shown as a sectional elevation in Fig. 10. The original type of this machine was hampered by the drawback that air was drawn in from the outside in drawing the sand from the lower sand box, thus lowering the working pressure and the efficiency

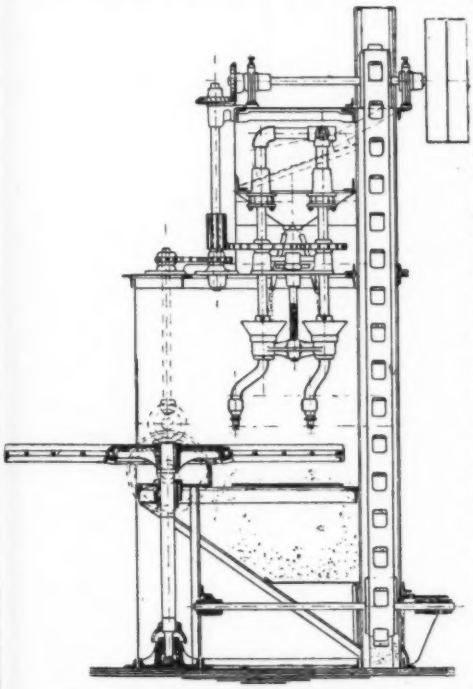

FIG. 10.—SANDBLAST CLEANING MACHINE, BY VOGEL & SCHEMMANN.

of the machine. In the improved pattern, both the spent sand from the grating and the new sand are raised by an elevator, passed through a screen, and dropped into a sand box on the way to the nozzles. The sand tap enables the feed to be adjusted, and no motive power is consumed by the feed. The nozzles have also been made adjustable without stopping the machine, which is an advantage when cleaning castings of varying dimensions, since it enables the blast to be delivered in the most effective manner, without stopping the machine. An additional improvement is the visible sand circulation, which enables the operator to see that the feed is not choked and to remove any obstruction without difficulty. Uniformity of action is secured by rotating the nozzles.

The same firm has introduced a revolving drum machine for cleaning small castings, especially red brass castings (see Fig. 11). This also is of the automatic type, the castings being placed in the slowly revolving drum (one revolution per minute), where they are turned over and over each other and acted upon on all sides by the sand blast. A feature of this machine is the absence of flexible pipes, which are always getting out of order and proving a source of great inconvenience in working. The nozzles are arranged so that the supporting arms traverse the side walls of the drum and distribute the sand uniformly over the castings. The spent sand is passed through a cleaning screen into the lower sand box, and is raised thence to be mixed with fresh sand for use over again. The dust generated in the drum is removed by an exhaust. The machine can also be used for cleaning fittings, and for blowing out cores after the core irons have been withdrawn.

Fig. 12 is a combined cleaning plant, with a long narrow fixed nozzle mounted above the table and discharging sand vertically downward. Other conditions being equal, the working capacity of this machine is in proportion to the way in which the table surface is fully utilised and filled with castings. Pieces of complex form need turning over again when treating this type of machine.

The smaller type of machine, shown in Fig. 13, has also fixed nozzles. The castings are laid on the table by hand, through holes provided for that purpose, and the progress of the work can be watched through peep-holes, the interior being lighted by incandescent lamps. Dust is drawn off by a compressed air exhaust, and automatic sand circulation is provided.

A cleaning machine of an entirely different type is that of the Badische Maschinenfabrik, Durlach, illustrated in Fig. 14, since in this case the sand, instead of being forced through a nozzle by compressed air, is discharged against the castings on the revolving table by means of a kind of paddle wheel with hardened cast paddles, driven at high speed by a belt. The ordinary sand blast

can only work with fine sand that does not offer any appreciable resistance to the air blast; but with the machine now under consideration the size of the grains does not make any difference, the entire mass of the sand being moved at uniform speed by the wheel, so that coarser material can be employed and the cleaning action increased. In fact, in certain cases, even gravel or granulated iron can be used along with the sand. Of course, this treatment is reserved for special cases, such as castings that are encrusted with partially fused moulding sand. In other respects the machine works like the ordinary revolving table machines. The castings are laid on a slowly revolving table, which is perforated to allow the spent sand to fall through; and above this is the casing surrounding the wheel, which is generally set at a distance of about 16 in. above the level of the table. One revolution is generally sufficient to clean one side of the castings, which can then be turned or removed. A leathern or rubber apron is arranged across the opening, to prevent the escape of coarse sand and dust. The spent sand is raised by an elevator and fed to the wheel over again. The advantage of this machine over the compressed air type is the smaller consumption of motive power, only 6 h.p. being required to drive one with a table 80 in. in diameter.

Different means are employed for cleaning large castings, engine frames, cylinders, etc.; automatic treatment being impossible. On this account the work has to be performed in special cleaning sheds. The Gutmann shed has already been described, but despite its other advantages, has the defect that the operator is obliged to stand inside the shed, so that the lower part of his body at least is exposed to an unhealthy strong draught; and there is no absolute security that the exhaust air current will entirely prevent the dust getting into the man's lungs. These defects are claimed to have been obviated by the

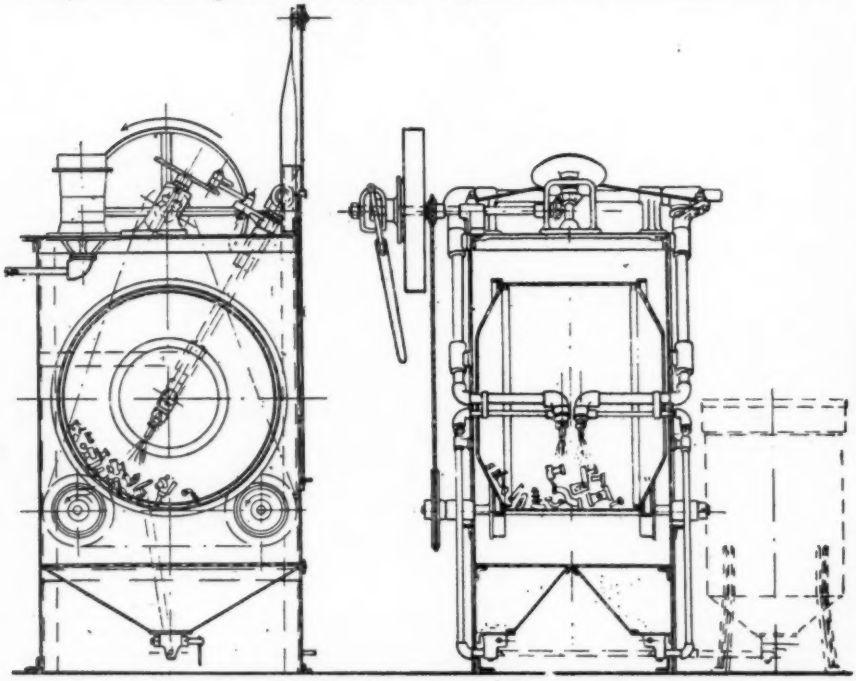

FIG. 11.—SANDBLAST CLEANING MACHINE WITH REVOLVING DRUM, FOR SMALL CASTINGS: BY VOGEL & SCHEMMANN.

Vogel & Schemmann shed (Fig. 15). A turntable, driven at low speed from shafting by spur and chain gearing, is

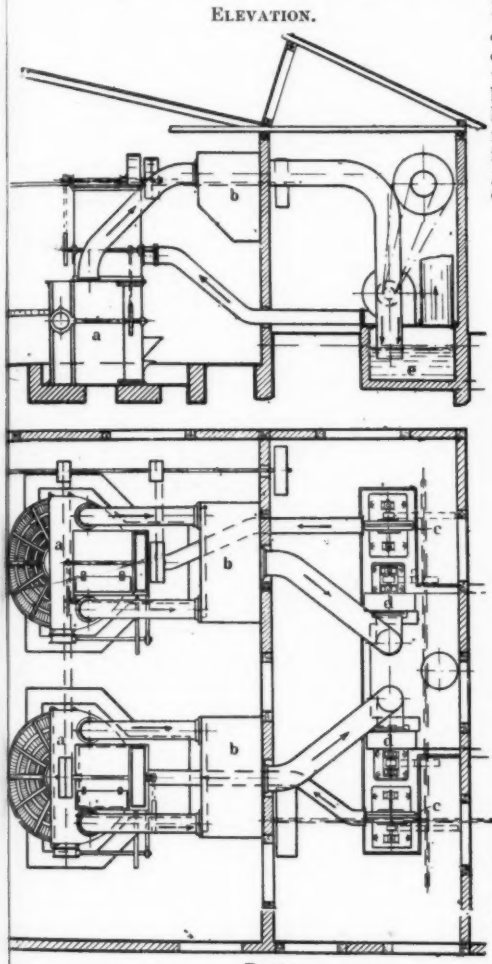

FIG. 12.—COMBINED SANDBLAST CLEANING PLANT.

(a) Dust Cage. (b) Sand Box with Screen. (c) Exhaust. (d) Water Tank. (e) Exhaust Air Pipe.

mounted in a brick-lined pit. The casting is packed on a truck and run in on the rail track on to the turntable, the shed door being then closed. The shed is closed in all round by wooden walls, an opening being left in the front wall for the insertion of the sand blast nozzle, whilst above this, on the level of the eye, are windows through which the operator can watch the progress of the work. The interior of the shed may be lighted by other windows or incandescent lamps. When the turntable is set in motion, the casting revolves slowly in front of the working aperture, and the jet can be suitably directed by the operator, who is able to move freely

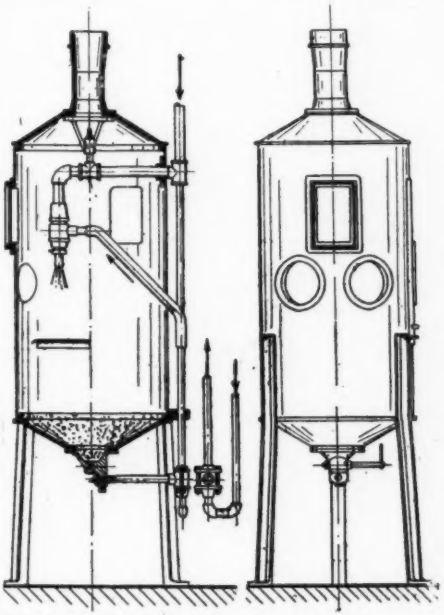

FIG. 13.—SMALLER TYPE OF COMBINED SANDBLAST CLEANING PLANT.

and is protected from the dust, which is removed from the interior of the shed by a centrifugal exhaust through a flue in the roof, a settling box being provided in this flue to collect any sand carried off with the dust. The heavy particles of dust are blown through a vertical pipe on to the surface of a water tank built in the foundations of the exhaust fan, whilst the lighter particles pass through the fan and are forced by the vanes against the surface of the water in another part of the tank. The shed may also be used for cleaning long castings,

such as pillars, pipes, and so forth, these being mounted on the truck and moved along the shed, in front of the sand blast, and then drawn out through the opposite door. The spent sand falls down into a gutter between the turntable and the brickwork, and is pushed by a scoop attached to the turntable into a hopper, whence it is returned to the nozzle, the circulation being thus automatic. A similar plan is adopted in the complete plant illustrated in Fig. 16, the castings being cleaned by a nozzle introduced

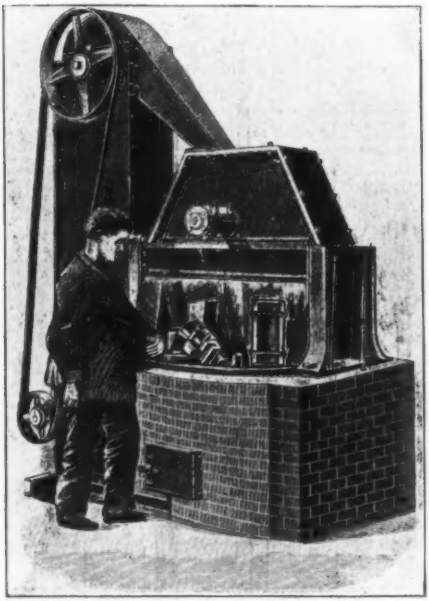

FIG. 14.—SANDBLAST CLEANING MACHINE, BY THE BADISCHE MASCHINENFABRIK DURLACH.

from the outside. The dust is drawn off through a pipe underneath the perforated plate by a centrifugal exhaust in the same manner as described above. The sand falls into a worm conveyor, which carries it to an elevator, raising it to the sand box for use over again.

The plant, by the same makers, shown in Fig. 17, is chiefly intended for cleaning bronze statues, etc., but can also be used for engraving monuments, marble slabs, etc. The sand blast nozzle is not held in the hand, but is directed by turning a hand crank outside the shed, and can be easily moved in any direction. The dust is drawn off by a fan, as in the other machines described.

Fig. 18 represents still another arrangement of sand blast cleaning shed specially designed for complicated castings with numerous cores; cleaning the brazed joints of cycle frames, etc. The shed is of wood or sheet iron, and the nozzle is mounted to blow downward. The castings, etc., to be treated are held under the nozzle, and can be cleaned on all sides. The progress of the work is observed through a window in the front wall of the shed. The spent sand falls through the table grating into the lower sand box, and is returned to the nozzle automatically. The dust is exhausted in the usual way. As shown in the figure, any number of these sheds can be erected side by side, each one being fitted with a separate nozzle and operated independently of the others.

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A PLEA FOR LOWER BLAST PRESSURES IN CUPOLA AND AIR FURNACES.*

By WILLIAM H. COLEMAN.

NOT so long ago blast pressures of 22 to 24 ozs. at the wind box and in the supply pipe to the cupola were deemed necessary to make good castings. Although considerable changes have been made, tending to increase the capacity and economy of cupola practice, yet some adhere to what may be termed high blast pressures.

Modern practice calls for greater height of charging doors from bottom of cupola, larger wind box, and greater tuyere area, together with larger pipe for air supply. Formerly, where coal was used in cupolas, the fuel ratios predominating were as high as six and five to one, and the total tuyere area ranged down to as low as 10 per cent. of the area of the cross section of the inside lining of the cupola.

In those days, even with the high blast pressures then used, clogging of the tuyeres was quite commonly observed. In a cupola of 48-in. diameter inside the lining, we should have a cross section of 1,809.56 in. The area of the tuyeres would equal about 7 per cent. of this, or 126 square in. In order to force the

* Abstract of Paper read before the American Foundrymen's Association.

required amount of air through this restricted area, a comparatively high pressure of at least 16 to 18 ozs. was required, but by doubling this tuyere area either by putting in more tuyeres or having them larger, up to 20 or even 25 per cent. of the cross section of the inside diameter of cupola, a lower blast pressure can be used, the volume of air remaining the same. A rapid increase in friction

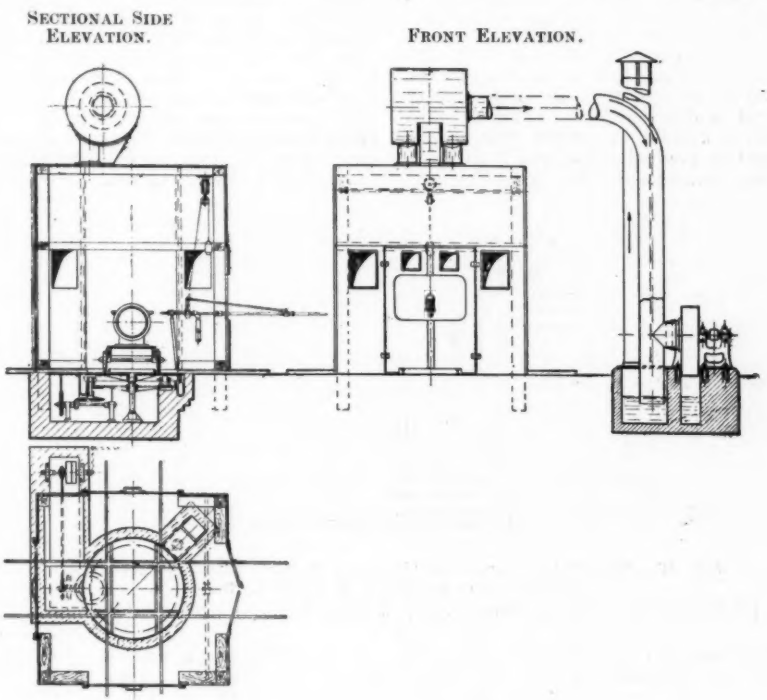


Fig. 15.—Sandblast Cleaning; the Vogel and Schemmann Shed.

results from higher velocities. It is a convincing argument in favour of large areas and low velocities.

In order to get a large volume of air through restricted tuyere area the blast pressures must be correspondingly high. Cupola builders recognise that enlarged tuyere area is an advantage, but some of them continue to recommend higher blast pressures than are commonly used among the best informed managers. The substitution of coke for coal as a fuel seems to make larger volumes of air necessary, and the soft by-product coke, while having the properties of an ideal cupola fuel, must be mixed with the harder cokes, and requires more oxygen than the hard cokes of the east, and, therefore, more air to make it melt iron rapidly.

It is now undoubtedly the best practice to use lower blast pressures to such a point as the consequent lower capacity will admit of. It is, of course, agreed that if capacity only is to be considered, then the higher blast pressure must be employed.

Air furnace operators are greater sinners in regard to high blast pressures than those with cupolas. The correct volume and blast pressure for air furnace work depends upon the rate of coal consumption on the grate per square foot per hour and the quality of coal used. Heed should be paid to whether the coal is heaped high on the grate and whether or not the furnace is crowded.

The air supply pipes under the grates, and those for the top blast, should be of ample size and fitted without abrupt curves or elbows. In this way low blast pressures may be utilised, and consequently considerable power may be saved. The low pressure type of fan is the more economical for air furnace work.

In an air furnace under proper working conditions there is little reason for the down blast through small thimbles to support combustion where the volumes and velocities of the air under the grates are proportionally arranged. If the thimbles are enlarged up to at least 3 in. diameter in the 8-ton furnace, and at least 4 in. diameter in the 10-ton furnace, and are fitted to a supply pipe with a funnel or gradual taper, and if they are of sufficient number, they will offer very little frictional resistance to the air. If all these conditions are fully met there will cease to be any reason for high velocities or high pressures of air in this type of furnace. You can blow more of a flame down by four thimbles of 3 in diameter at 2 ozs. pressure than with five thimbles of 1½ in. diameter at 6 ozs. pressure, because the combined thimble or tuyere area is greater.

To pass 100 cubic feet of air per minute through a pipe whose diameter is 2½ in., requires an air velocity of 3,000 ft. per minute, while through a 4 in. pipe, with a velocity of 2,300 ft. per minute, double the amount of air may be passed.

The experience of fan engineers (fan engineering is now recognised as a distinct and special line of engineering) shows that 200 to 300 cubic feet of air is required to burn 1 lb. of coal, and that the pressures should be 1¾ ozs. to 2¼ ozs. under the grate for air furnace work. Assume 20 lbs. to 40 lbs. of coal per square foot of grate and allow 15 to 25 per cent. additional air for the down blast, and make openings and pipes of ample area, letting the air for down blast be supplied at same pressure as that below the grates. Under this change of conditions from high velocities of air through small thimbles, some air furnace operators will complain of not getting enough pressure. They never complain of "not getting enough air." If you must have air, and plenty of it, in your down blast, make your openings large and use the proper type of fan—the volume fan and not the cupola fan.

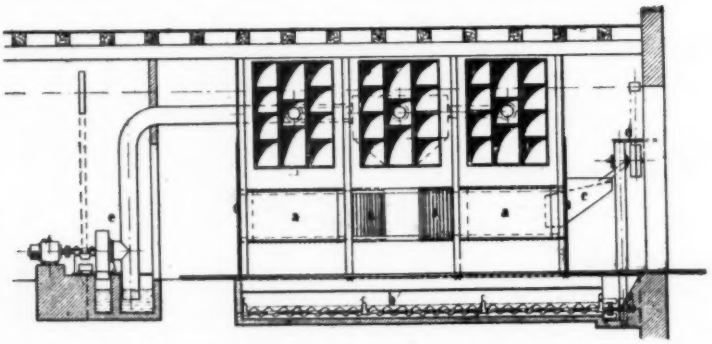


FIG. 16.—SANDBLAST CLEANING CHAMBER WITH WORM CONVEYOR FOR SPENT SAND; BY VOGEL & SCHEMMANN.

(*a*) *Draught Curtains.* (*b*) *Wire Screen.* (*c*) *Sand Box.* (*d*) *Elevator.* (*e*) *Exhaust.*

It is sometimes claimed that the introduction of this down blast throws the flame over on to the iron in the bath. It seems to the author that the use of this down blast at high pressure is one of the reasons why the ratio of fuel to metal is 60 per cent. instead of 30 per cent., which is at least the theoretical ratio.

The air furnace is subject to great wear and tear; this can undoubtedly be lessened, as in the cupola, by using low pressures.

The author thinks that if there is a sufficiency of air under the grates, and if the air spaces in the grates are proportioned properly, the combustion will be all that is required. The introduction of cold air beyond the bridge wall tends

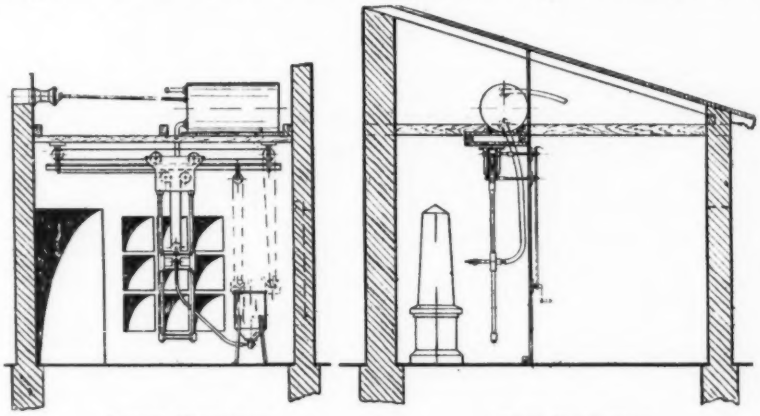
to cool off the gases of combustion and interferes very materially with the draught through the stack.

The position and shape of the tuyeres sometimes play a part in the proper distribution of the blast, and their height should be determined with due regard to the character of the work done, and the charging of the cupola should be changed accordingly. For heavy castings the tuyeres should be higher than for light castings, and for stove castings a very low position of tuyeres is advisable, as the melting is practically continuous.

While the author advocates low pressure in cupolas for the reasons above stated, he is not an advocate of scanty volumes of air supplies through enlarged tuyere area. Under some conditions the desire for a high rate of melting outweighs other considerations and high pressures of blast must be used.

Even with limited cupola capacity, the loss in melting capacity at the cupola with low pressures is often more than made up in the machine shop by decreased cost in working up the product, as low pressures produce a soft casting easy to machine by reason of less loss of silicon and manganese by oxidation. Higher strength for the same reason is obtained under low pressures.

Combustion is never complete in a cupola. It requires a certain amount of oxygen to support combustion, and



FRONT ELEVATION. SIDE ELEVATION.

FIG. 17.—SHED FOR CLEANING BRONZE STATUES, ETC., AND FOR ENGRAVING MONUMENTS, MARBLE SLABS, ETC.
SANDBLAST CLEANING SHEDS BY VOGEL & SCHEMMANN.

volume or supply of air. Many foundrymen are using blowers far below the required capacity in volume; therefore, they are compelled to speed up their blowers in order to get the necessary volume, thereby getting, incidentally, higher pressures than are essential to do the work, with poor results in their products, together with rapid destruction of cupola lining. This is undoubtedly one of the most important reasons for existence of high pressures in many foundries. High pressures give a greater melting capacity for a given size cupola, but better results at a less cost for power can certainly be obtained by using larger cupolas with lower pressures and larger volume is fundamentally far more essential than pressure.

The action of the blast in the cupola is to oxidise a small portion of the carbon in the iron, and of the silicon and manganese also. Per contra, the iron absorbs some carbon from the fuel, sometimes sufficient to more than offset the loss of oxidation: not so with silicon. This is oxidised in proportion to the pressure or the intensity of the flame. A sufficiency of silicon produces soft castings by preventing the formation of combined carbon. Any increase of combined carbon increases the hardness of the castings. The oxidation of silicon and manganese is all the way from 5 per cent. in the

small cupolas to 20 per cent. in the largest ones, and pressure has no doubt considerable influence in affecting its quantity.

Excellent results may be obtained by using low pressures of blast from both fan and positive blowers in connection with various classes of foundry work, from castings for heavy flywheels, engine and pump cylinders, stove work, and castings down to ½ oz. in weight. A large number of those using positive blowers are working under the lower pressures. In order to change from a high to a low pressure, of course the question of volumes must be considered, and the foundryman must arrange his iron mixtures and fuel accordingly. Sometimes he must also change his manner of charging. But it will pay him to do this and melt at low pressures, unless, for instance, he is making sash weights from sheet metal scrap and old tin cans; or in case the cupola output per hour is the greatest consideration, or the castings require no machining, or their appearance is of no consideration.

With the high pressure, extra loss by oxidation of silicon and manganese is only compensated for by purchasing the grades containing higher amounts of silicon, *i.e.*, paying more for the iron by reason of rapid melting.

The iron as it comes from the spout of the cupola is far above its melting point. No definite rule can be given for the temperature at which it should be poured to meet the different requirements of different kinds of work. However, it is recognised that in pouring for thin castings, particularly those having small cores and thin projections, hot metal run slowly into the moulds is the best practice. Heavy castings having few or no cores can be poured much more rapidly, and the iron need not be so hot.

It is good practice, when making a line of goods where duplication is possible, and where the daily requirements are known, to arrange for hot iron and rapid pouring. This can be done when heats are long and practically continuous, where temperatures and fluidity can be run high. When I see the modern car wheel foundryman pouring hundreds of 700-lb. wheels per day in chills, I often ask myself, "Do the stove foundrymen really know what hot iron is?" They require at least 2 per cent. silicon in their castings, but as you lower your rate of silicon, so you can raise the temperature of pouring your metal.

Having discussed high and low blast pressures in the cupola, let me explain further by reference to Tables I. and II.

For high blast pressures in cupolas we have the following capacities shown in Table I.:—

TABLE I.—*Cupola Capacities with High Blast Pressures.*

Dia. inside lining in inches.	Capacity per hour, tons melted.	Pressure in ounces.
18	¼ — ½	8
23	½ — 1	10
27	1 — 2	10
32	3 — 5	12
37	5 — 6	12
42	6 — 7	12
45	7 — 9	14
48	9 —10	14
54	10 —12	14
60	12 —14	16
66	13 —18	16
72	18 —21	16
78	21 —24	16
84	24 —27	17

For low blast pressures we have the following capacities shown in Table II.:—

TABLE II.—*Cupola Capacities with Low Blast Pressures.*

Dia. inside lining in inches.	Capacity per hour, tons.	Pressure in ounces.
18	¼ — ½	5— 7
23	½ — 1	5— 7
30	2 — 3½	6 — 8
35	3 — 4	7 - 8
37	4 — 5	7—10
42	5 — 6	7—10
45	6 — 7	8—10
48	7 — 8	8—10
54	8 — 9½	9—10
60	10 —12	10—12
66	12 —15	10—12
72	16 —18	10—12
78	19 —22	12—14
84	21 —24	12—14

I consider the pressures in Table I. to be the maximum allowable or permissible for the best work, and they insure the greatest melting capacity in a given sized cupola. Very few foundrymen, however, care to utilise such high pressures as shown in Table I., for several reasons:—

1. Because they find they can get their required capacities at the lower blast pressures by using larger cupolas.

2. Because the cupola lining will last longer under lower pressures.

3. Because oxidation of the silicon and manganese is greater under high pressures.

4. Because the resultant castings are easier to machine when made under the lower pressure.

5. Because there is less slagging under the lower pressure, owing to the fact that you do not force the cupola.

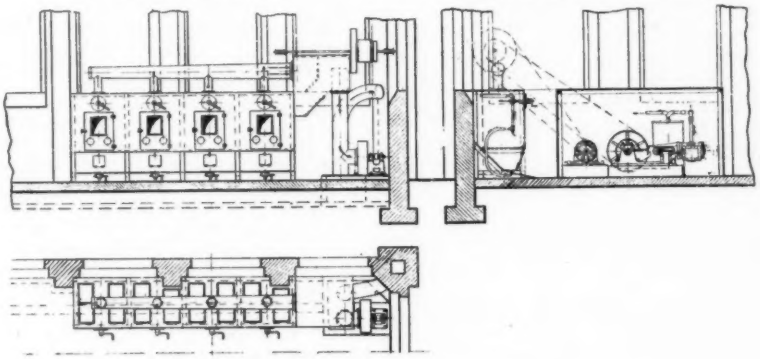
6. Because greater strength in castings is obtained in melting at the lower pressures, all other things being equal.

7. Because the horse-power required per ton melted is less at low pressures than at high pressures.

Recapitulation.

Eighteen to twenty ounces might be designated as extremely high pressures in cupolas from 54 in. to 74 in. inside diameter of lining, and these pressures were formerly used with coal as fuel and with small tuyere area. Low pressure, good sand, dry moulds properly rammed and vented with good facing mixtures, together with reasonably hot metal having good fluidity, will make the smoothest castings. The sulphur bugbear, together with the clogging up of tuyeres, has ceased to be a terror to the foundryman who knows his business.

FRONT ELEVATION. SECTIONAL SIDE ELEVATION.



SECTIONAL PLAN.

FIG. 18.—SHEDS FOR CLEANING COMPLICATED CASTINGS WITH NUMEROUS CORES, ETC.; SANDBLAST CLEANING SHEDS BY VOGEL & SCHEMMANN.

While I have never seen a cupola with too much tuyere area, I have stated definitely a limit. The tuyere is necessarily cut down considerably during the heat, and unless you have surplus tuyere area to start with, you will find you are short in area during the latter part of the heat. Modern cupolas have greater tuyere area than cupolas formerly made, but even this is frequently enlarged to meet the demands of increased melting capacities at lower blast pressures, particularly when only the lower tuyeres are utilised.

A number of foundry foremen do not use the blast gate. Unless a blast gate is used while operating a centrifugal fan with full volume capacity for cupola, the operator will not be able to get exactly the same quality of iron at all periods of the heat. Even users of positive blowers are now installing regulating rheostats to control pressure and volume of air blast during the heat, where previously this matter was not considered essential.

Absorption of Sulphur by Slag.

Low blast or pressure with sufficient volume will give hot iron and good fluidity. Many will say they get good hot iron with good fluidity at pressures lower than those in Table II.

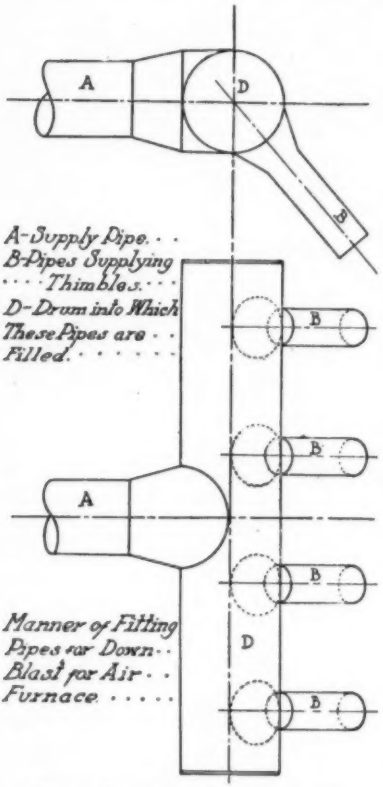
However, with pig-irons and coke high in sulphur, the rate of melting has considerably to do with the amount of sulphur that will be absorbed in the castings. Fast melting permits the iron to absorb but little sulphur in comparison with slow melting, under abnormally low pressures. This possibly is one of the greatest arguments for fast melting.

Horse-Power Per Ton Melted.

If we assume the price of a horse-power is £9 per year, the 30-ton heat will cost only from 6s. to 8s. If we assume the iron to be 1½d. per lb. of casting, the cost of this power is 1-1,000th of 1 per cent. of the total cost of the iron, or 2¼ thousandths of a halfpenny per lb. Of course, if greater power is used a larger motor will have to be purchased, and the added expense of installation is more than the added expense of operation.

If larger cupolas with lower blast

pressures are used the same capacity per hour may be obtained as with smaller cupolas, and considerable horse-power be saved in consequence thereof. I do not mean to assume that the amount of air may be indefinitely increased by enlarging the tuyeres and not increasing the pressure. This may be done to a certain extent, but we soon reach a point where



BLAST PIPES FOR AIR FURNACE.

the equivalent area through the charge in the cupola is less than the tuyeres. If we take, for instance, two 84-in. cupolas to which are to be supplied 24,000 cubic feet of air per minute at a 10-oz. pressure, it will be found from a table of velocities that 216 square inches area are required for the passage of 24,000 cubic feet of air per minute. The combined tuyere area of two 84-in. cupolas is 1,264 square inches, or about six times the area required to pass the stated amount of air at a velocity due to a 10-oz. pressure. In other words, it is the resistance of the charge which regulates the amount of air which can be forced through the cupola at a given pressure by any type of blower, and not altogether the area of the tuyeres, when these tuyeres are of a size which will make their total area larger than that which is required to pass the requisite amount of air. Just as increase of the tuyere area in a blast furnace would permit of a low pressure blast being used, so certain kinds of charges in cupolas require a higher blast pressure to force the air through them, regardless of any increase in tuyere area. By this I do not mean to belittle the importance of the size, arrangement, and position of the tuyeres in the cupola. This is, as I have said, of great importance, but I think does not largely affect the volume when high pressure is used, particularly when obtained by means of the displacement blower.

The pressure limits the volume carried by any given pipe. In other words, a 12-in. pipe will carry a fixed volume of air at 8 ozs. pressure, but a larger volume at same pressure requires a larger pipe. It is, therefore, apparent that increased tuyere area and properly proportioned supply pipe, and ample area in wind box, is desirable for low pressure when using the centrifugal fan blower. Inversely, when tuyeres are small, higher pressures are required to obtain the volume necessary, and then a blower of the displacement principle is required.

I find that the amount of air required to melt a ton of metal per hour depends principally upon the size of cupola, the ratio of coke to metal used in melting, the character of the coke, and the manner of charging. In a cupola, air is blown over the melted metal, not through it; the oxidation of carbon is slight and incidental, not fundamental and complete, as in a converter when air is blown through the metal. The volumes in Table III. are approximately correct for air required per ton melted per hour :—

TABLE III.

	Cub. ft. of air per hour per ton of iron per hour.
6 lbs. iron to 1 lb. coke ...	33,000
7 " " " ...	31,000
8 " " " ...	29,000
9 " " " ...	27,000
10 " " " ...	25,000

The average is about 30,000.

Conclusions.

Less pressure required for coke than for coal.

More volume required for coke than for coal.

Larger tuyere area required for coke than for coal.

Coke more rapidly chilled by high velocity or pressure.

Tuyeres and lining will not burn out so quickly under the low blast pressures.

Too much air will reduce the temperature of the gases and retard combustion, particularly when introduced in top row of tuyeres.

The blast should be started at low pressure, and increased up to the maximum pressure required during the heat. The pressure should be lowered again at the end of the heat, for the reason that having less metal in cupola and more space around it, oxidation of silicon in the iron and the consequent hardening of the castings is prevented. Choked tuyeres are prevented by having large tuyere area with plenty of volume at low pressure, good iron and good fluxing.

Blast pressure is advisable, provided the cupola is large enough to give the required melting capacity, and provided the blast pressure is not reduced enough to make melting unreasonably slow.

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PATTERN MARKS.

By L. Tibbenham.

In a large factory making a great variety of machines, a system embodying a practical way of marking patterns is a necessity, and of as much importance as an up-to-date cost system. Yet we often find marks put on patterns in a kind of haphazard way, or where there are several departments, each has a style of marking of their own, which, of course, is apt to lead to confusion.

This is all bad practice, and lacks uniformity, and the longer a firm delays in having a system, the worse things get. Although many engineers are fully aware of this, its use and importance is ignored and thought not to be worth trouble or consideration.

Meaning and Importance of Marks.

The most important point is to have a mark that will enumerate exactly the size, class and number of the part, to enable the workman and storekeeper to find the article required with ease and certainty. At the same time, this is most essential to the "Registrar," as by this means only is it possible to make an absolutely correct register of all the component parts for the complete machine, which is necessary if the repairable parts are to be delivered with a positiveness of their fitting exactly, thus avoiding the unpleasantness of sending the wrong part as well as the extra expense entailed.

Class Symbols.

It is as well to fix on all the "class" symbols first. For this purpose, a list of all the different classes of goods must be drawn up. This list must be made as complete as possible, by adding such manufactures as the firm anticipate making. To simplify our pattern marks, all these classes are represented by one or more letters, and it is desirable to arrange these letters from the initials of the various classes, such as T, for traction engines, LT, light traction, CT, compound traction. Of course, in a large manufactory it is often impossible to continue in this manner without repeating, and then other means of adopting letters that is most expedient must be followed; but so long as a distinct symbol is given for every class manufactured, our object is attained.

Size Letters.

Now we must give another letter to indicate the various sizes in each class. This we will call the "size" letter. In arranging the marks, it is better for identification if this precedes the "class" letter. Again, it simplifies matters if the "size" letters follow on consecutively, such as A-2HP, B-3HP, C-4HP, etc. When large engines are being made, we could start from the smallest in a similar manner, A-100HP, B-120HP, C-150HP. So long as the "size" marks are arranged systematically and consecutively, is all that is wanted, to ensure this easy means of identification, that is being aimed at.

Numbers.

We already have two symbols which indicate to us the size and class of our pattern, thus leaving the numbers of the component parts. Complications arise here, especially if a great variety of goods are being manufactured with a large number of parts in each. Consequently, great care must be taken in fixing the numbers for these detail parts.

Take each class and draft out a complete list of every part, that is requiring a pattern mark, keeping all the parts as

much in groups as possible, such as cylinders, gearing, governors, valve gear, etc.

Master Key Ledger.

Arrange all these names of parts in a register, ruled as Fig 1, with numbers running consecutively. This is the master key. If the same part (name only) appears in another class, it is only necessary to enter same once. It is as well to leave spaces after each group for additions. A detail index book or card index is useful to assist in finding the numbers in the master key ledger.

Number.	Name of Part.	Superseded by
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

Pattern Mark Requisition Form.

How to obtain a number is the next question. This is easily explained by referring to Fig. 2, which requisition form has to be filled up by the draughtsman and given to the booking clerk, the latter returns same after filling in the numbers from the master key ledger, the draughtsman having previously filled in all the other details.

Marking Altered Patterns.

If a pattern that has already got a mark is altered in any way, it must have a new mark, or better still a letter, a, b, or c, following the original number. The whole system and usefulness breaks down, if this rule is not enforced most emphatically.

Stamping the Patterns.

Patterns are often used for several sizes with various slight alterations to cores or bosses, etc. Under these circumstances, all the numbers must be stamped on the pattern that it is used for, and when given out to the moulding department, the correct number is attached by the pattern storekeeper. In all cases, it is preferable to stamp the numbers on the patterns, as often the proper symbols get knocked off, and there will then be no difficulty in identifying the patterns.

Brass Work.

Standard brass details such as unions, lubricators, cocks, valves, etc., need not have any class letters, but simply the numbers and size symbol. Where the articles are too small, or machined all over, and there is no room for cast letters, the marks must be stamped on the parts after they are finished. This is best done by the storekeeper on receiving same into his store.

Sizes of letters and figures used must be left to the pattern-maker. They must not be too small, and are best tacked on, in a prominent place, on some outside surface which is not machined.

The last column in the requisition form referring to "the old pattern marks" is most important, as this is the only means the book-keeper has of knowing whether new size and class letters are required, or only a new number (or simply to add an affix whichever system is adopted), so great care must be taken to always give this information. Otherwise, the elaborate system would be necessary in order to keep a record of absolutely every mark given out, which would require too much of the human element to work same successfully.

Referring again to the master key ledger, the last column will not be required if an affix is attached to the number, when making an alteration to the pattern.

It is not suggested that the system detailed above is the one and only, but it is simple and elastic, and can be applied to any class of goods manufactured.

Fig. 1.

Pattern Mark Requisition Form.

Drawing No..... Date..... Short Title on Drg. } .....

Name of Part requiring Mark.	Size.	Class	Number.	If Pattern is being altered, give old mark.

Sig. of Draughtsman..... Sig. of Book-keeper.....

Fig. 2.

BRITISH STANDARD WAGES OF IRONFOUNDERS AND PATTERN MAKERS.

The Board of Trade have just published a special report on standard time rates of wages in the United Kingdom at October 1, 1906, which shows the following figures for some of the leading industrial districts:—

	Iron-founders. s. d.	Pattern-makers. s. d.	Hours per week.
Northern Counties and Cleveland—			
Darlington	39 0	37 0	53
Gateshead	38 0	39 0	53
Middlesbrough ...	39 6 to 40 6	39 0	53
Newcastle-on-Tyne	38 0	39 0	53
Sunderland	37 0 to 39 0	39 0	—
Workington ...	36 0	—	
Yorkshire, except Cleveland—			
Bradford	39 0	38 0	53
Leeds	39 0	38 0	53
Sheffield	40 0	40 0	54
Wakefield	38 0	—	—
Lancashire and Cheshire—			
Bolton...	40 0 to 42 0	39 0	53
Crewe	32 0 „ 38 0	34 0	54
Horwich	36 0 „ 38 0	—	—
Liverpool	40 0 „ 42 0	39 6	53
Manchester	41 0	40 0	53
Salford	40 0	40 0	53
Stalybridge	40 0	—	—
Wigan...	40 0 to 42 0	37 0	53
North Midland Counties—			
Derby	38 0	36 0	54
Gainsborough ...	30 0	—	54
Nottingham ...	38 0	38 0	54
West Midland Counties—			
Birmingham ...	38 0	38 0	53
Bristol	36 0	38 3	54
Dudley	32 0 to 34 0	36 0	54
Gloucester	34 0	34 0	54
Wednesbury ...	33 0 to 38 0	—	—
West Bromwich ...	—	38 0	54
Wolverhampton ...	32 0	36 0	54
South Midland and Eastern Counties—			
Northampton ...	31 0	—	—
Norwich	28 0	—	—
South-Eastern Counties—			
Chatham	38 0	—	—
Erith	40 6	43 10½	54
Portsmouth	34 0	36 0	48& 54
Southampton ...	37 0	—	—
Wales and Monmouth—			
Barry Dock	36 0	—	—
Cardiff	36 0	38 0	53
Newport	35 0	36 0	54
Swansea	36 0	38 3	54
Scotland—			
Dundee	0 8½*a*	34 0	54
Edinburgh & Leith	0 8½*a*	37 1½	54
Glasgow	0 8½*a*	38 3	54
Greenock	0 8½*a*	38 3	54
Johnstone	—	36 0	54
Kilmarnock... ...	—	35 0	54
Paisley	—	38 3	54

a Rate per hour recognised by the Associated Ironmoulders of Scotland.

The figures submitted show that there are wide differences between one part of the country and another. The highest wages appear to be reached at Wigan and Bolton; the lowest at Norwich—which is an almost purely agricultural region—Gainsborough and Northampton. Between the maximum and the minimum of these localities the wages of ironfounders differ by as much as 14s. per week, with a difference in hours against the lower wage. Erith, which may be taken as representing London wages, pays 2s. 6d. per week more than Chatham, and 6s. 6d. per week more than Portsmouth. The hours of labour are pretty uniform throughout the country, and the average may be taken at 53½ weekly.

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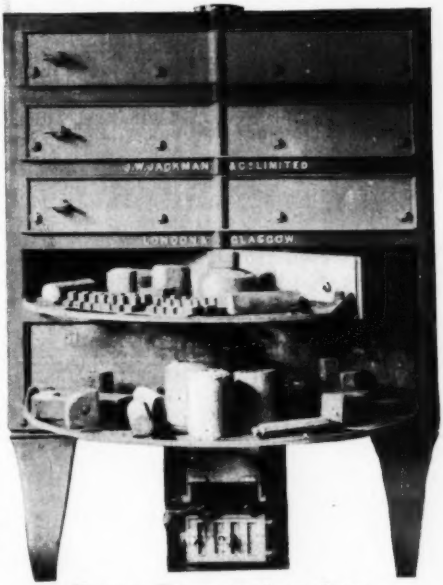
THE HILFRIF PORTABLE CORE OVEN.

This oven has recently been placed on the market by Messrs. J. W. Jackman & Company, Limited, of Caxton House, Westminster, and, as will be seen from the annexed cut, is distinctly novel and compact in design. It will be seen that the shelves, which are semi-circular, are mounted on a central pivot, so that they can be swung round outside the oven for the purpose of loading them with cores, and at the same time no escape of heat takes place, as the door attached to the shelves closes the oven just the same when the shelves are outside the oven as when they are loaded with cores and re-



Hilfrif Portable Core Oven.

turned to the oven. There are five shelves; the lowest allows for cores up to 10 in. in depth and the four upper ones have a 6 in. space. The oven is 24 in. in depth and 48 in. wide. It will be seen that the shelf room in this oven compares very favourably with that in other portable core ovens of the same size, and the advantage it possesses in entirely preventing the escape of heat in loading and unloading will be appreciated by every practical foundryman.

BRITISH FOUNDRYMEN'S ASSOCIATION.— BIRMINGHAM BRANCH.

Lecture by Professor Turner.

THE fortnightly meeting of the Birmingham Branch of the British Foundrymen's Association was held at the Technical School, Suffolk Street, on Saturday, 17th ult.; there was a good attendance, Mr. R. Buchanan, the local President, occupying the chair.

Professor T. Turner, of the Birmingham University, gave an address on "Shrinkage and Volume Alteration during Cooling."

The CHAIRMAN introduced the lecturer as a specialist of world-wide reputation, and a most distinguished metallurgist, especially in regard to cast iron. His own association with the Professor extended over 18 years, commencing about the time when the Professor announced the great fact of the true influence of silicon on cast iron. That declaration was made in opposition to great authorities. But it now stood as a recognised truth. The declaration emphasised the enormous importance of the study of cast iron, and had led a large number of people to devote themselves to that study. It had, in fact, opened up a new era of investigation, which was very far from nearing its close. Many devoted workers were still investigating the effect of the different elements on cast iron and on one another, and they had heard that Professor Howe, of America, had made something like 3,000 experiments with carbon and cast iron, endeavouring to find some deeper law governing the different effects that a varying percentage of carbon has upon pure iron, and at the end of his experiments he practically said he did not know anything about the subject. He thought that a somewhat modest way of stating the position. But there were simpler problems connected with the subject of carbon and iron on which they would have thought some finality could be reached. The problem was still greater when they considered the effect of sulphur, phosphorus, and manganese.

PROFESSOR TURNER then delivered his address, which in the main embodied the matter contained in the paper published this year by the Iron and Steel Institute, and which was read at a recent meeting. In a few preliminary remarks the Professor acknowledged the value of the practical work done by Mr. Buchanan when the facts were not so well recognised as now. Mr. Buchanan was one of the earliest to show by actual tests forwarded to himself for examination that his (the Professor's) own theory as to the influence of silicon really was correct. But he might add that he always had the greatest possible assistance from practical men, while the men who had disputed this conclusion had been the theoretical men, the teachers, and the book writers. Researches had recently been published dealing with the relation of silicon to cast iron, and the whole matter had been raised in the "Journal" of the Institute. It was now suggested that white iron gave the best results. His own criticism on that was that obviously the people who suggested that must be wrong because it did not agree with the practical experience of the last twenty years. When they asked why the results were wrong, they were acknowledged to be irregular by the author. The answer was (1) that the test was altogether wrong, and (2) because of the way the curves were arranged in the paper. The author of the theory had endeavoured to show that one and one are two, and for that purpose he took one horse and one cart and added them together.

The lecturer proceeded to enumerate a number of facts generally accepted by ironfounders, as follows:—(1) That a casting is smaller than the pattern or the mould; (2) that the difference in size varies with the shape and the mixture; (3) that thin castings contract more than thick ones; (4) that grey iron contracts less than hard or white iron; (5) that solid cast iron floats on fluid cast iron; (6) that during solidification in a mould, especially with large castings, the fluid metal in the gate rises and falls; (7) that graphite in the form of "kish" separates from molten grey iron; (8) that rapid cooling hardens cast iron; (9) that on

prolonged heating, white cast iron becomes "annealed"; (10) that grey cast iron is permanently expanded by repeated heatings.

Dealing next with the various methods of measuring contraction, a description was given of the test devised by Keep, of Detroit, which the lecturer considered the simplest and least expensive. Speaking generally, they found that the more siliceous the iron the less was the contraction, while any element that made iron hard increased the contraction. As to the effect of the rate of cooling, the temperature at which metal is poured, some of these have not been properly determined. A number of diagrams were given showing the exact progress of contraction, with the succession of "arrests" or temporary expansions. The rule clearly was that the higher the silicon the greater the expansion. With little silicon there was practically no expansion.

After enumerating the expansions in various irons, the lecturer said they had not met with any substance showing more than three arrests. In conclusion, the lecturer said they could answer with confidence a number of questions. For instance, they could say that carbon iron does expand during cooling, and that the expansion is in accordance with its known composition at certain definite times and temperatures, and if they had a diagram showing the cooling curves of a sample of pig-iron they would know approximately its chemical composition, and should know the mechanical purpose to which it could be applied. For instance, if they know the amount of phosphorus in a sample they should know whether it was a strong or weak iron.

Discussion.

Mr. F. J. Cook thought the special value of the lecture was that it pointed to the value of another mechanical test as a help to foundrymen who are not good at chemical analysis. A mechanical test which would give reliable information was a step in the right direction. He had himself had Keep's test in operation for three or four years, and he could recommend it as a very useful test. But it required to be carefully done, because it was easy to get one bar bigger than the other. If done properly, they could get it through in ten minutes, and for certain classes of work it was the best. But it was better to measure the bars on the ramming up plate. There were other things that regulated shrinkage besides silicon. But when the foundryman knew which was the softer iron he could regulate shrinkage accordingly. He had had cases where plates which had gone all right for a year or two had suddenly started buckling, and by taking a shrinkage test he found they had altered the mixture, and by further modification he stopped the buckling. He would like to know whether when the large expansion took place it affected the molecules and caused the sponginess or openness. Possibly that might cause the leakage that sometimes occurred?

Mr. Thomas said there was a vast amount of scientific knowledge that could be applied to the foundry. He understood that the expansion shown by the curves was due to the eutectics, and not to chemical changes. It seemed to have been proved that the arrest might take place with absolutely pure iron, and that was due to the allotropic modification of the iron which took place during the process of cooling. They had almost come to the belief that phosphorus had practically no effect on the carbon of the iron. But from the observations of the lecturer the phosphorus seemed to have considerable effect whether it combined it or separated it out. He would like to know whether high silicon led to greater contraction?

A Member inquired with regard to the saturation of pig-iron with graphite, which produced "kish," whether that super-saturation with graphite was the result of all those spongy places in the castings, and whether the graphite separated out at a higher temperature than other elements present in the iron? Possibly that might have the effect of producing those cavities in large castings. He had noticed that those cavities generally appeared near the gate.

Mr. Mason said that as moulders they had not much chance for mechanical experiment. The lecture explained what was happening between the casting and the solidification and would go a long way towards helping them in their difficulties in the foundry. They found the shrinkage holes a fearful poser, especially when they occurred apparently without any change in the quality and composition of iron.

Mr. F. J. Cook said his trouble in the way of blow-holes generally came when he had used scrap day after day, and the iron had increased in purity. In other words, the greater the percentage of pure iron the more liability to shrinkage. He

had repeatedly overcome the difficulty by putting in a little raw pig-iron. The iron he was thinking about had a total carbon of 3 per cent., and the silicon was about 1¼ per cent.

Mr. Mason said his experience was exactly opposite to that. He had found that they got over the difficulty by increasing the scrap.

The Chairman said shrinkage and blow-holes were like King Charles's head. They thrust themselves into every discussion. So far as he knew, there was no complete explanation which could be given. He had found that the melting in a different cupola of the same iron was sometimes followed by blow-holes. He attributed it in some degree to the amount of sulphur taken up by the molten iron from the bed of coke which was of different depth in the two cupolas. He would like to know precisely what took place when the iron was "growing." It might be a re-arrangement of crystals or a growth of the graphite already in the casting. Iron could not grow 40 per cent. without very considerable changes.

Professor Turner, replying to the questions, said that where they had a third expansion very pronounced they would get what was generally called a spongy iron, which would not give a sound casting. As to whether high silicon led to greater contraction, they had not carried the experiments sufficiently far with the rich alloys to be able to say. But he was rather inclined to anticipate that it would. As to the effect of phosphorus on carbon, the reason they said that phosphorus had no effect on the carbon within range, meant that they generally had phosphorus in the proportion of 1½ to 2 per cent. in ordinary foundry iron. The writers who had contributed to that subject had been dealing with 4, 6, and 8 per cent. With high phosphorus they found the carbon low; the carbon tended to be combined. As to the formation of spongy places, there was no doubt that "kish" did produce them, and dirt might also have that effect. On the other hand, they had those holes in very hard iron. The experiences of Mr. Mason and Mr. Cook showed that the sponginess was due to a disturbance of the proper proportion. He thought those two gentlemen might exchange pigs occasionally. The extreme expansion in iron was very like the raising of bread from dough; they could blow out the dough without really making any more of it. He had no doubt that silicon had an expellant effect on the carbon. It broke up what would otherwise be carbide.

The proceedings concluded with a hearty vote of thanks to Professor Turner, who, in responding, suggested they should take the opportunity of a future meeting to pay a visit to the University.

Manchester Branch.

The monthly meeting of the British Foundrymen's Association was held in the Manchester Technical School on November 3.

A discussion on "Troubles in the Foundry" was opened by Mr. Markland, of Bolton, with a highly interesting and instructive dissertation on the cracking (by contraction) of open-sand plates, which led to some very important features and results being arrived at by the members present.

The committee, who have arranged for a very interesting programme of papers and discussions to take place in the present session, expressed a desire that a continuance of the increase in membership might be obtained, and offers to all those to whom foundry matters are of interest a cordial invitation to the meetings, which are held on the first Saturday in each month at 4 p.m. in the Technical School, Sackville Street, Manchester. Particulars regarding the Association may be had upon application to the secretary, Mr. C. C. Bransby, 74, Urmston Lane, Stretford, Manchester.

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CORRESPONDENCE.

DEFECTIVE PIPE AND COLUMN CASTINGS.

To the Editor of the Foundry Trade Journal.

Sir,—We have for some considerable time been troubled with defective castings, especially where parts have to be turned; for instance, a pipe or column which has to be turned at both ends. I find near the gate particles of what looks like slag; also spongy places. We get our iron down fairly hot. Can any of your readers give me a suggestion?

Yours, etc.

Foreman.

PINHOLES IN OPEN SAND PLATES.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I have been making some open sand plates, which have, roughly speaking, an area of 70 or 80 square feet, and they are about 1 in. thick. Most of them are covered with pinholes on the top side, which vary in depth up to ½ in. These holes do not occur in all the plates, and in those plates where they are present they show in patches and not all over.

I have varied the mixture very considerably, having made them out of a good No. 4 pig and a little scrap, and, on the other hand, nearly all scrap and a little pig; also out of a No. 3 iron, which ran very fluid. I have also "doctored" the metal by an addition of ferro-aluminium to aid the escape of occluded gases—but all to no purpose.

If any of your readers have had any experience in such a case, I should be glad to receive any advice they may offer.

Yours, etc.,
"OPEN SAND."

CRUCIBLE STEEL CASTINGS.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We have a well fitted up brass foundry, and at times would like to make a few crucible steel castings. Could any of your readers give us the necessary information; it would be greatly appreciated. Are there any books on the subject?

Yours, etc.
SUBSCRIBER.

SCABS.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR.—As a reader of your journal I shall be greatly obliged if you can let me know in your columns what causes scabs. I may say that my foundry is only a small one, and I am making round pig troughs about 3 ft. diameter, and, when they are turned out, they have various scabs on them. If any of your readers can assist me I shall be greatly obliged.

Yours, etc.
"EAGLE."

TRADE TALK.

MESSRS. J. H. COOK and W. H. DE JERSEY, ironfounders, Bradford, have dissolved partnership.

AN outbreak of fire occurred recently at the Derwent Foundry, Derby, but the damage was not serious.

THE BENNETT IRONFOUNDRY COMPANY, LIMITED, have transferred their business to Green Lane, Stockport.

MESSRS. A. STEVENSON & COMPANY have started business at the Bonnington Welded Boiler Works, Leith.

IT is understood that another Bolton engineering firm are about to transfer their works to Little Hulton.

IMMEDIATE discharge from bankruptcy has been granted Mr. W. Tattersall, mechanical engineer, of Bradford.

MESSRS. HENRY BESSEMER & COMPANY, of Sheffield, have taken over the works of the Bolton Iron and Steel Company.

THE engineering works of Messrs. J. Waddington & Sons, Barrow-in-Furness, have been considerably damaged by fire.

THOS. FIRTH & SONS, LIMITED, Sheffield, have removed their London office to 8, The Sanctuary, Westminster, S.W.

MESSRS. G. WAILES and R. P. WAILES, mechanical engineers, Euston Road, London, N.W., have dissolved partnership.

A RECEIVING order has been made in connection with the affairs of Messrs. Craik Brothers, engineers, Newcastle-on-Tyne.

STEWARTS & LLOYDS, LIMITED, the well-known tube manufacturers, of Coatbridge, propose erecting a steel foundry at Burnbank.

A FIRE has occurred in the marine engineering works of Messrs. Dunsmuir & Jackson, Govan, doing damage estimated at £30,000.

THE CHATTERIS ENGINEERING WORKS COMPANY, have removed their London office to 139-140, Gresham House, Old Broad Street, E.C.

A RECEIVING order has been made in connection with the affairs of Mr. A. Fengl, engineer and tool-maker, Altrincham, Cheshire.

BULLER'S, LIMITED, engineers and ironfounders, have acquired property adjoining their Tipton Works, suitable for future extensions.

A COMPANY has been formed, and ground acquired near Balmore Road, Possilpark, for the erection of a new roof and bridge works.

MESSRS. W. L. DOBBIE & COMPANY, 68, Gordon Street, Glasgow, have been appointed Scottish agents for Mr. C. W. Taylor, engineer, South Shields.

MR. J. MELLING, Dashwood House, New Broad Street, London, E.C., has been appointed London representative for John Wood & Sons, Limited, Wigan.

A DISSOLUTION of partnership is notified in connection with Messrs. J. Wright and T. Wright, deceased, engineers, etc., Platt Bridge, near Wigan, Lancashire.

J. L. THOMPSON & SONS, LIMITED, have leased a piece of ground at Sunderland, for carrying on the business of ship and engine builders and repairers.

CAMMELL, LAIRD & COMPANY, LIMITED, have opened a branch office at 28A and 29, Collingwood Buildings, Newcastle-on-Tyne, under the charge of Mr. J. Johnson.

JORDAN FOUNDRY, Newport, which has been closed for over 12 months, has been dismantled, and a company has been formed with a view to rebuilding the works.

THE SHROPSHIRE IRON COMPANY, LIMITED, have decided to share their profits with their workpeople, having granted their millmen and puddlers a bonus.

MESSRS. F. SMITH, E. BARKER, and G. H. WILSON, engineers' tool makers, Ovenden, Halifax, have dissolved partnership, so far as regards F. Smith, deceased.

HADFIELD'S STEEL FOUNDRY COMPANY, LIMITED, are supplying the London County Council with special track work, points, and crossings, amounting to £20,000.

MR. J. R. HORTON, 59, Bishopsgate Street Within, E.C., has been appointed London agent for Sybry Searls & Company, Limited, Cannon Steel Works, Sheffield.

THE SLOAN ELECTRICAL COMPANY, 16, John Dalton Street, Manchester, have been appointed Lancashire agents for the Perfecta Seamless Steel Tube and Conduit Company.

THE Italian State Railways have recently placed an order for 1,000 freight wagons with the American Car and Foundry Company, of Trafford Park, Manchester.

DAVIES BROTHERS & COMPANY, LIMITED, Crown Galvanised Iron Works, Wolverhampton, have removed their London office to West India House, 96, Leadenhall Street, E.C.

SAMUEL FOX & COMPANY, LIMITED, of Stockbridge, are making very extensive additions to their works, including the introduction of electricity as motive power in the place of steam.

MR. P. J. PARMITER has severed his connection with Messrs. P. J. Parmiter & Company, engineers, Station Works, Tisbury, Wilts, and has started business at Harrow Works, Tisbury.

THE special work at the crossovers and at the car-sheds of the Great Northern, Piccadilly, and Brompton Railway, has been carried out by Hadfield's Steel Foundry Company, Limited.

T. S. FORSTER & SONS, LIMITED, Copperas Bank Forge, Sunderland, have lately added to their various departments, and are now completing the erection of a large machine shop.

MESSRS. J. A. MILLEN & SUMMERVILLE, Tradeston Iron Works, Glasgow, are supplying the ironwork, etc., in connection with the new wagon shops at Brassie, of the Glasgow and South-Western Railway Company.

THE thirteenth National Engineering and General Trades' Exhibition will be opened at the Bingley Hall, Birmingham, on March 28, 1907, and will remain open over two months. The engineering and metal trades' section will include mechanical engineering, iron and brass founding and casting, etc.

MESSRS. T. DAVIES & SON, Railway Iron Works, West Gorton, Manchester, are busily engaged upon the manufacture of cupolas and other foundry plant, including a complete melting plant consisting of cupolas, charging platform, electric hoist and electrically-driven blower, which are to be erected at the works of John Summers & Sons, Limited, Shotton, Flints.

MESSRS. J. W. JACKMAN & COMPANY, LIMITED, have installed at their warehouse, 347, Chester Road, Cornbrook, Manchester, a Mumford moulding machine of the latest type, together with suitable air compressor, so that the machine can be seen in operation, and foundrymen who are interested in modern moulding machinery will no doubt find it worth their while to pay a visit of inspection.

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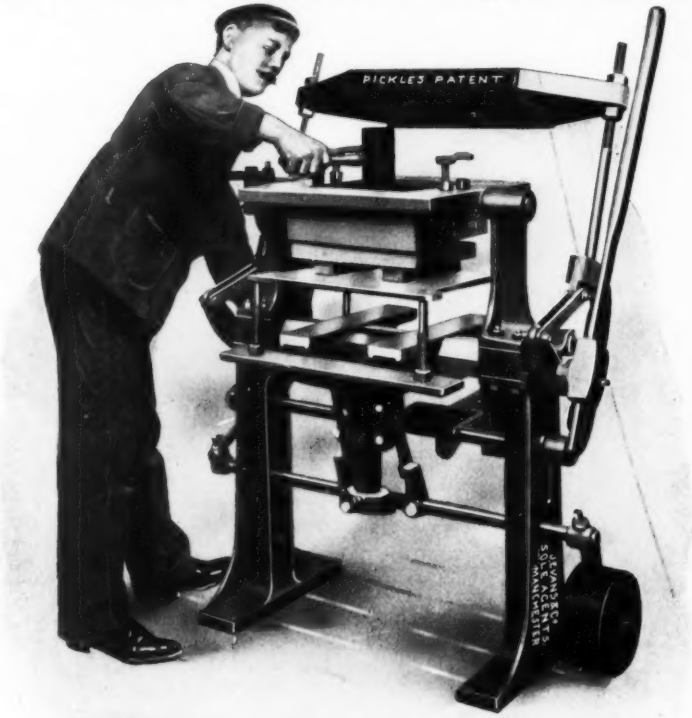

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NEW COMPANIES.

ABBOT ENGINEERING COMPANY, LIMITED.—Capital, £10,000 in £1 shares.

HOPKINSONS, LIMITED.—Capital, £100, to carry on the business of mechanical engineers, etc.

LINCOLN STEEL CASTINGS AND VACUUM BRAKE COMPANY, LIMITED.—Capital, £20,000 in £1 shares.

H. BARTLETT & COMPANY, LIMITED.—Capital, £3,000, to carry on the business of brassfounders, etc.

AUTOMATIC ENGINEERING WORKS, LIMITED.—Capital £50,000 in £10 shares. Registered office: 3, Budge Row, E.C.

GELDARD PATENTS LIMITED.—Capital, £2,000. Registered office: Tudhoe Grange Foundry, Spennymoor, Durham.

LEE & MOSS, LIMITED.—Capital, £3,000, to take over the business of engineers carried on by J. Lee at Station Road, Oswestry.

HAMMOND LANE FOUNDRY, LIMITED.—Capital, £9,000, to acquire the business carried on at the Hammond Lane Foundry, Dublin.

THOS. MELVIN & SONS, LIMITED.—Capital, £15,000, to acquire the business carried on at St. Rollox Iron Works, Charles Street, Glasgow.

MILLFIELD FOUNDRY (SUCCESSORS TO JAMES MOORE & SONS), LIMITED. Capital, £20,000. Registered office: Millfield Foundry, Millfield, Belfast.

JONES & CAMPBELL, LIMITED.—Capital, £60,000, to acquire the business of general ironfounders, carried on at the Torwood Foundry, Larbert.

VAUGHAN & COOK, LIMITED.—Capital, £7,000, to carry on the business of engineers, etc. Registered office: 298A to 300A, Goswell Road, London, E.C.

LLEWELLYN & CUBITT, LIMITED.—Capital, £15,000, to acquire the business carried on by W. Cubitt at the Rhondda Engine Works, Pentre, Glamorgan.

W. PARHAM, LIMITED.—Capital, £1,000, to acquire the engineering business carried on at Bath by F. J. Parham. Registered office: Northgate Iron Works, Upper Bristol, Bath.

WILLIAM SPARROW, LIMITED.—Capital, £14,000, to take over the business of William Sparrow, engineer, Martock, and of the Somerset Engineering and Wagon Works. Registered office: The Works, Bower Hinton, Martock, Somerset.

DEATHS.

MR. J. MILBURN, owner of the Hawkshead Foundry, Workington.

MR. JOHN DEVONSHIRE ELLIS, chairman of John Brown & Company, Limited.

MR. J. W. TAYLOR, who founded the well-known firm of bell makers at Loughborough.

MR. W. M. SMITH, of the locomotive engineering staff of the North-Eastern Railway.

MR. F. BRADLEY, owner of the Clensmore Foundry, Kidderminster, at 63 years of age.

MR. C. V. BUNTING, a well-known figure in the Sheffield iron and steel industry, aged 66.

MR. H. H. EADON, of the firm of Henry Eadon & Sons, of the High Bridge Forge, Owlerton, Sheffield.

THE EARL OF CRANBROOK, very largely interested in the Low Moor Iron Works, Low Moor, Bradford.

MR. L. DOUGAL, of Bathgate, who had a life-long connection with the Bathgate Foundry Company, aged 75.

MR. W. B. STEWART, at one time connected with D. Y. Stewart & Company, Limited, of St. Rollox, Glasgow.

MR. J. ROWAN, senior partner in the firm of David Rowan & Son, marine engineers, Glasgow, aged 53 years.

MR. J. C. JOBLING, until recently the general manager of the Glengate Iron Works of Messrs. J. Stewart & Company.

MR. R. B. EVERED, aged 69, chairman of Evered & Company, brassfounders, Smethwick, Birmingham, and Drury Lane, London.

MR. T. A. LOVEBAND, of Dowlais. Deceased, who was about 50 years of age, had been engaged in engineering works and ventures in Workington and the Midlands.

MR. HUGH WADDLE, proprietor of the Waddle Patent Fan and Engineering Company, Llanmore Works, Llanelly, and patentee of Waddle's patent ventilating fan.

MR. G. MILLS, of S. Russell & Company, Limited, ironfounders, Walsall, aged 52 years. The deceased gentleman was appointed chairman of S. Russell & Company, Limited, when the Company was converted into a limited liability concern.

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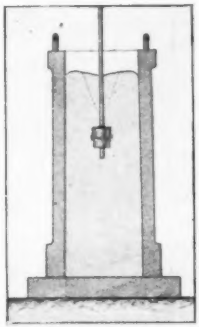

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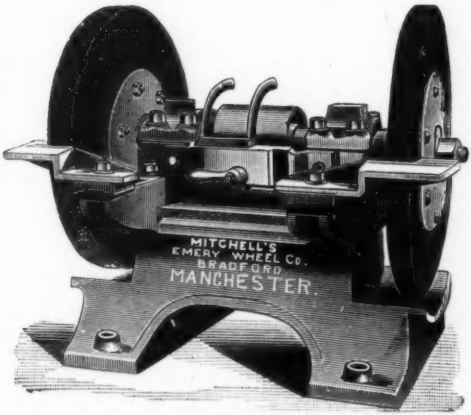

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PERSONAL.

THE late Mr. T. Haycock, ironfounder, of Ashbourne, left estate of the gross value of £7,251.

MR. D. SINCLAIR, of the Sinclair Iron Company, Limited, has been made a J.P. for Shropshire.

THE late Mr. J. G. Cox, of Messrs. Cox & Company, engineers, Falmouth, left estate valued at £5,835 gross.

LIEUTENANT-COLONEL SIR ARTHUR J. BIGGE has been elected a director of R. & W. Hawthorn, Leslie & Company, Limited.

SIR CHARLES MCLAREN, BART., M.P., has succeeded the late Mr. J. D. Ellis as chairman of John Brown & Company, Limited.

MR. J. FIELDING, of Fielding & Platt, Limited, Atlas Iron Works, Gloucester, is the new High Sheriff of the city of Gloucester.

THE late Mr. J. Thornton, of Messrs. Thornton & Crebbin, ironfounders, Bradford, left estate of the gross value of £20,575.

MR. E. S. JOHNSON, of the Barry Graving Dock and Engineering Company, Limited, has been appointed senior general manager of the Wallsend Dry Docks and Pontoon Ship-Repairing Works.

MR. C. COUSINS, managing director of Penney & Company, Limited, City Iron and Steel Works, Lincoln; Mr. C. Duckering, Waterside Iron Works, Lincoln; Mr. G. S. Haslehurst, director of Clarke's Crank and Forge Company, Limited, Lincoln; and Mr. H. Johnson, steel founder, of Tennyson House, Lincoln, are all directors of the Lincoln Steel Castings and Vacuum Brake Company, Limited.

AMONGST the new Mayors elected during the month we note Mr. W. Anderson, J.P., managing director of Head, Wrightson, & Company, Limited, for Thornaby; Mr. A. J. Smethurst, retired ironfounder, for Warrington; Mr. R. A. Bradshaw, of Messrs. Bradshaw & Sons, ironfounders, for Retford; Mr. W. Murray, secretary of the Wallsend Slipway and Engineering Company, for Wallsend.

ELDERS FOUNDRY COKE

As supplied to the

British . .

Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

Ganister, Cupola Blocks, Fire Bricks,

Fire Clay.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

Steel Moulders' Composition, Silica Cement.

J. GRAYSON LOWOOD & Co., Ltd.,

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

WHY BUY NEW CUPOLAS?

When you can have old ones converted, at small cost, by introducing

HIGHAM'S HOT BLAST PROCESS.

A Saving is effected in Coke of at least 25% on small furnaces.

I will adapt existing Cupolas to my process, allow a month's free trial, and if any dissatisfaction be expressed at the results, restore the cupolas to their former condition.

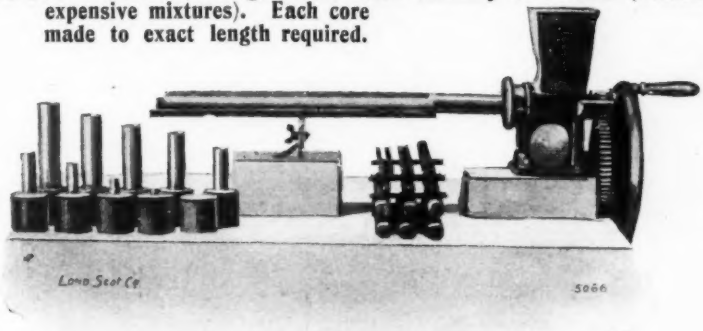
JAMES HIGHAM, Iron Founder,

BROOM LANE, LEVENSHULME, MANCHESTER.

CORE MACHINES.

ROTARY TYPE for the rapid production of small straight cores of round, square, oval, and other sections.

PISTON TYPE for larger sizes with ordinary core sand (avoiding expensive mixtures). Each core made to exact length required.



Rotary Type Core Machines.

RAPID ECONOMIC CUPOLAS,
CORE STOVES AND ANNEALING FURNACES (Hislop's System),
MOULDING MACHINES, Etc.

HORACE P. MARSHALL & CO., LEEDS.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS.	1905-6.	1904-5.
Iron—Scotch pig warrants ... ton	*65/0	—
—Middlesbro' warrants ... ... ton	61/0	52/3
—W.C. M/nos Bessemer ... ... ton	74/0	70/9
—Stock, Scotch, Nov. 2 ...tons	9,380	16,200
Copper—Chili bars, GMB ... ... ton	£101 12/6	£78 0/0
—Stock, Europe & afloat... ... tons	14,243	13,690
Tin—English ingots ton	£198 10/0	£159 10/0
—Straits ... ton	£198 5/0	£156 10/0
—Stock, Ldn. Hlnd and afit ... tons	12,825	13,254
Lead—English pig ton	£19 16/3	£15 12/6
Spelter—Ord. Silesian ... ... ton	£28 2/6	£28 10/0
Quicksilver-(75lb.) bottle	£7 0/0	£7 5/0
Antimony—Regulus ... ... ton	£115 0/0	£51 0/0

*Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 15 0	to	7 5 0
Pipes, 1½ to 2½ in.	5 2 6	to	5 7 6
,, 3 to 4 in.	4 15 0	to	4 17 6
,, 5 to 8 in.	4 12 6	to	4 15 0
,, 10 to 16 in....	4 12 6	to	4 15 0
,, 18 to 24 in....	4 12 6	to	4 15 0
Chairs	3 17 6	to	4 0 0
Floor plates (open sand)	3 12 6	to	3 15 0

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows: —Heavy wrought (mixed), £2 14s. 6d.; light wrought, £1 7s.; heavy cast, £2 8s.; all per ton f.o.b., London. Copper (clean), £91 10s; brass (clean), £61 10s; lead (usual draft), £17; tea lead, £16; zinc, £20; all per ton delivered merchant's yard.

SILICA FIRE BRICK Co.,

OUGHTIBRIDGE.

GROUND GANISTER,

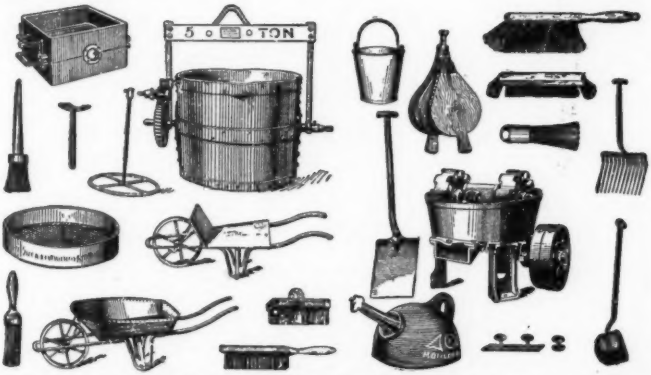
Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Better than Fire-clay Bricks for Cupolas.

Established 1863.

Jas. Durrans & Sons,



PHŒNIX WORKS, PENISTONE, Near Sheffield.

Manufacturers of all

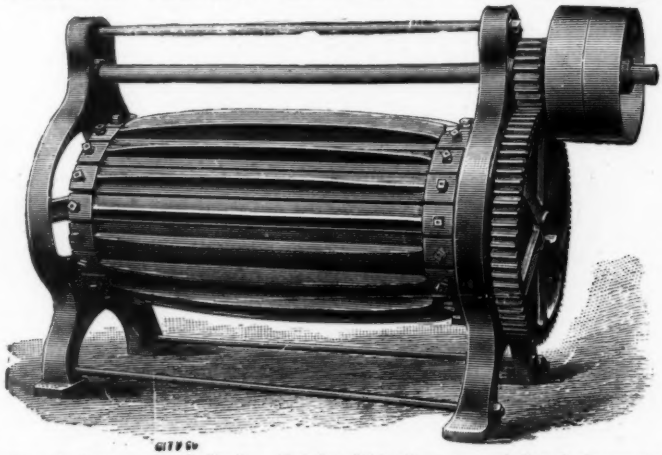
FOUNDRY EQUIPMENTS,

Composition Black Lead,

Plumbago, Core Gum, White Dust, and Coal Dust.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

"Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

In USE throughout the FOUNDRIES of the WORLD.

METALLIC CEMENTS

For ALL Purposes.

THOROUGHLY EFFICIENT AND RELIABLE.

PATENT EAGLE IRON CEMENT.
FUSIBLE CEMENT FOR CASTINGS.
FUSIBLE CEMENT FOR POLISHED SURFACES.
METAL CEMENT FOR FOUNDATION BOLTS.
IMPROVED DIAMOND CEMENT.

STEEL CEMENT
BRASS CEMENT
BRONZE CEMENT

Specially prepared for use in Steel, Brass and Bronze Castings.

The whole of the above Cements are specially prepared to fulfil the requirements of Iron and Steel Founders, Brass, Bronze, etc., Casters, and have attained their present large sale solely in virtue of their superiority.

They will save you BOTH Time and Money, therefore AT ONCE Write, Telephone or Telegraph for prices and particulars to

J. W. BAINBRIDGE,

143, 145, 147, Rosebery Avenue, LONDON, E.C.

Telephone:
11230 Central.

Telegrams and Cables:
"RUSSESCO, LONDON."

SITUATIONS VACANT & WANTED.

BRASS FOUNDRY FOREMAN, wanted at once; one thoroughly up-to-date in all modern practices. Able to take over complete control of Tabor Moulding Machines and Hand Moulders, Core Makers, etc. Must have first-rate knowledge of various alloys and correct heats for pouring same. Man with some American experience preferred.—Apply, stating salary expected and full particulars as to previous experience, to BOX., No. 612, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

FOR SALE AND WANTED.

FOR SALE, "Root's" Patent Foundry Blowers, &c.

No. 2 size by	"Thwaites"	8 in. outlet	£22.
No. 1	" "Allday's"	7 in. "	£20.
No. 1A	"	6 in. "	£20.
No. 3	" "Wilkinson"	6 in. "	£17.

Two 7 ft. by 4 ft. Vertical Boilers, as new, each... ... ... £34.

For full details address J. LIGHT, Wolverhampton.

TO BRASS FOUNDERS & ENGINEERS.—Complete Analysis of any Alloy, 25s.—L. PARRY, A.R.S.M., Union Bank, York, Huddersfield. Speciality—Brasses, Bronzes, Anti-Friction Metals. 12 years' experience.

FOR SALE.—One Foundry Cupola, 4 ft. 0 in. diameter, 18 ft. 0 in. high; in capital condition One Foundry Cupola, 5 ft. 6 in. diameter, 32 ft. 0 in. high: complete, with Air Belt, Stand Pipe, Valve, Elbow and Foundation Plate: a first-class Cupola. Overhead Hand-power Hand Travelling Crane, span about 21 ft. 9 in., to lift 8 tons, fitted with brake, to work by chains from below, by Spencer & Co., Hollingwood; a modern Crane in splendid condition.—Address Box 570, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

WANTED.—Wheel Moulding Machine with all modern appliances, to make wheels 18 ins. to 10 ft. diameter.—Apply CHARLES D. PHILLIPS, Emlyn Works, Newport, Mon.

STIGNIC PAINT.
NEWEST AND BEST WASH FOR STEEL FOUNDERS
PLASTIC CUPOLA GANISTER.
FINEST MATERIAL FOR LINING CUPOLAS AND FURNACES AND SETTING FIRE-CLAY BRICKS.
SPECIAL **STEEL MOULDERS' COMPO.**
STEPHENS & CO., Kidwelly.

FOUNDRY EQUIPMENT.
PATENT CORE MAKING MACHINES
No linseed oil or flour required.
NEW PORTABLE MOULD DRIERS
Moulds dried on the spot in an hour to one hour and a half.
J. W. & C. J. **PHILLIPS,**
23, COLLEGE HILL, London, E.C.,
And 7, PARK SQUARE, LEEDS.

COLD BLAST PIG-IRON.

M. & W. GRAZEBROOK,
DUDLEY.

FOUNDRY REQUISITES.

BRUSHES,	CHAPLETS & STUDS,	LADLES,
BELLOWS,	CEMENT,	RIDDLES & SIEVES,
BUCKETS,	CORE GUM,	SPADES, SPRIGS,
BARROWS,	CORE ROPE,	TERRA FLAKE,
BLACKING,	CORE TAPER,	FERRO-ALUMINIUM,
COAL DUST.	CRUCIBLES, CUPOLAS,	ETC.

MOOR & SONS, 1, Fennel St., MANCHESTER, (Dept. F.)
Established 1857. Telegrams "Acklam." Telephone, No. 3566.

BELT PULLEY MOULDING MACHINE.

For Single or Double Arm Pulleys.

For Straight or Curved Arm Pulleys.

For Split or Solid Boss Pulleys.

USED BY PULLEY MAKERS, MILLWRIGHTS, MACHINISTS, ENGINEERS.

Four sizes of **MACHINES** to make Pulleys from **4** in. to **60** in. dia., and from **12** in. to **30** in. face.

The London Emery Works Company, "Dept. C,"
Park, Tottenham, **London, N.**